PRECISION METAL MOLDING

FORMERLY DIE CASTINGS MAGAZINE

DESIGN • MANUFACTURE • FINISHING • USE

a salute to progress in

PRECISION METAL MOLDING

The initial issue of Precision Metal Molding represents the achievement of a new milestone in the systematic progress of the metal molding industry. The publishers have recognized the value of an impartial source of factual information to aid product designers and manufacturers in their search for the most advantageous casting process for their products.

Monarch Aluminum Mfg. Company, during the past 39 years, has developed widely-recognized production facilities for quality Aluminum Permanent Mold castings and Aluminum and Certified Zinc Die castings. These production methods have been individually recommended on the basis of an honest analysis of the ultimate benefit to the customer's end product.

Manufacturers, in many industries, have discovered that Monarch services go far beyond these three casting methods. Outstanding facilities for product finishing and complete assembly demonstrate Monarch's unique position to meet the most exacting specification.

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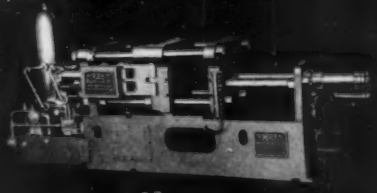

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SEPTEMBER 1951
Vol. 9 No. 9

PRECISION METAL MOLDING

DIE CASTINGS • INVESTMENT CASTINGS • POWDER METALLURGY
PERMANENT MOLD CASTINGS • PLASTER MOLD CASTINGS

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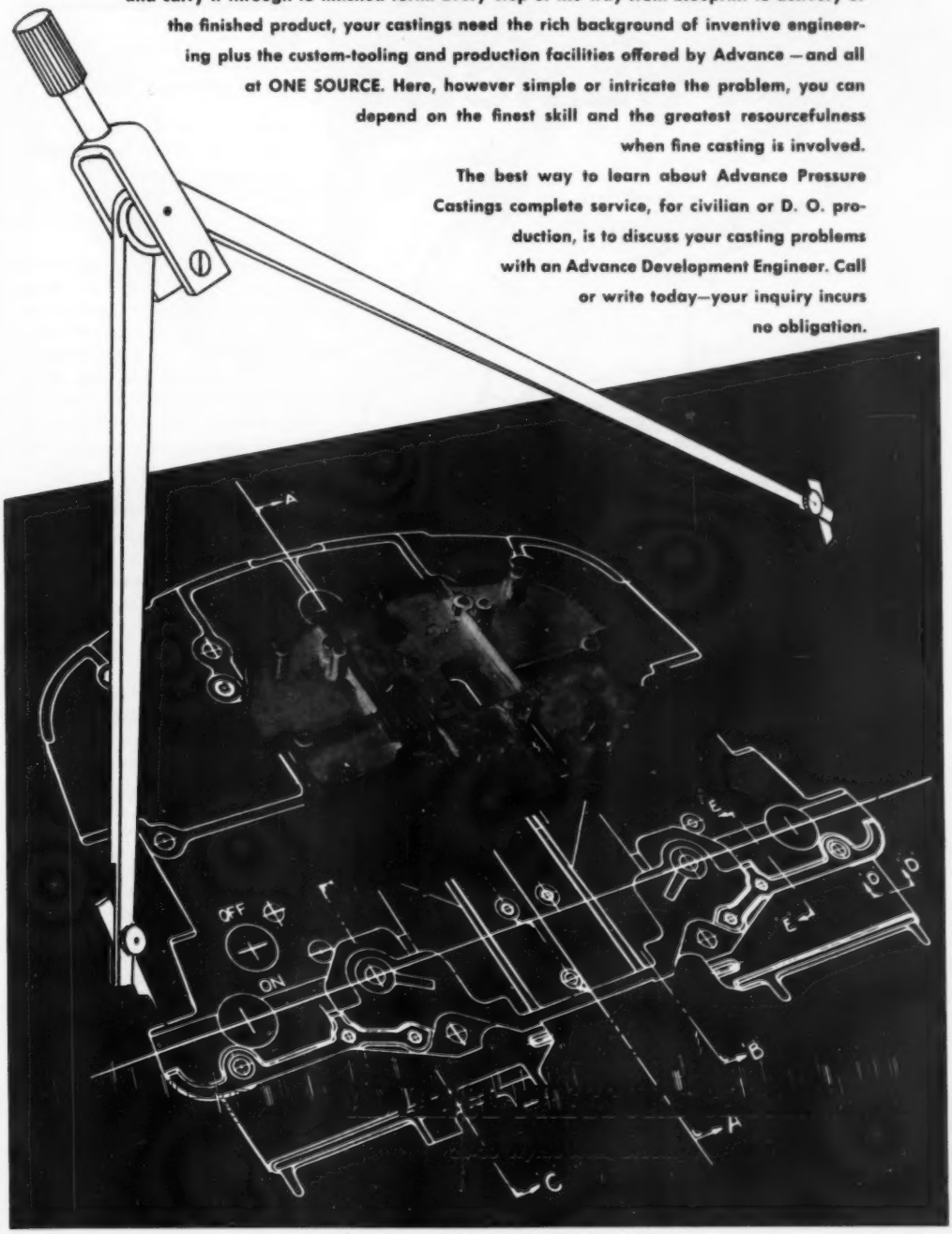

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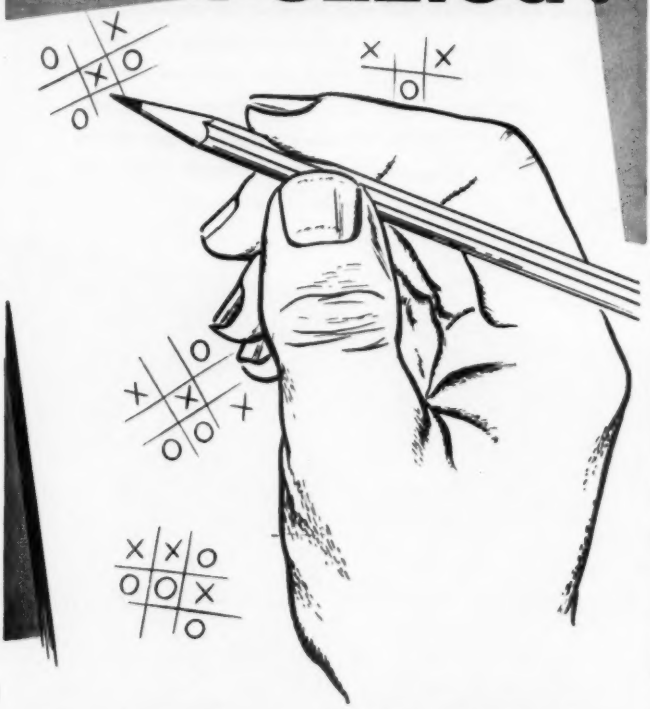

Yes, die castings are different. It takes more than machines to produce die castings.

Die Castings are Newton-New Haven's business. Here is an organization that has production and engineering talent to help you with your die casting problems.

Newton-New Haven has prepared a booklet on "Dimensioning Die Castings." This is basic data that every Engineer and Designer should have. Write on your company letterhead for your copy.

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LETTERS TO THE EDITOR

BARREL FINISHING SURVEY

From time to time this office distributes to our various manufacturing organizations a bulletin devoted to improvements in processing or equipment, which are considered applicable to our operations.

We are now preparing such a bulletin, to be accompanied by manufacturer's literature and catalogs, relating to barrel finishing and available equipment. In this connection, the article beginning on page 39 of DIE CASTINGS of May, 1951, is a very thorough and detailed presentation of American techniques in this field. We therefore wish to arrange to purchase 40 copies of this magazine. If you will advise us of the cost, we will enter an order therefor. We would prefer to distribute the complete magazine rather than tear sheets or a partial reproduction, because of the many other topics of interest therein.

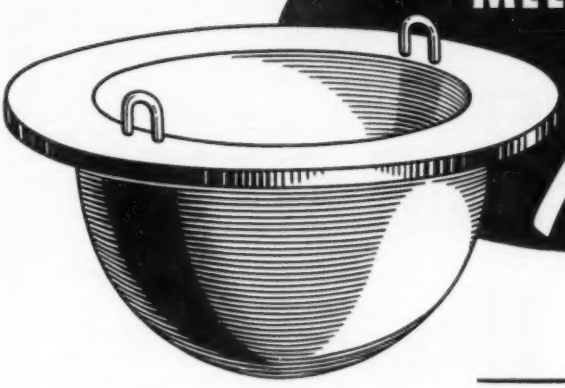
If however, this quantity is not available, or if for some reason you do not wish to supply them, we would request permission to duplicate, photostatically, that portion of the May issue which includes the above-mentioned article.—G.M.C.

There has been exceptional interest in the complete survey of barrel finishing techniques, equipment and materials, contained in the May issue. Expecting that this would be so, due to the excellent economy and effectiveness of this method for polishing, deburring, burnishing or coloring small die cast parts in bulk, we ordered extra copies to be printed of that issue. The response has been heavy, but there are still some copies available and we have been able to furnish the 40 copies, as requested.

Incidentally, the survey had, in connection with it, a directory of manufacturers of equipment and supplies for barrel finishing.—Ed.

continued on page 6

FOR THE BEST IN MELTING EQUIPMENT SPECIFY *Milles*



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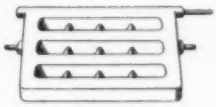

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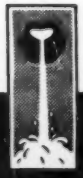

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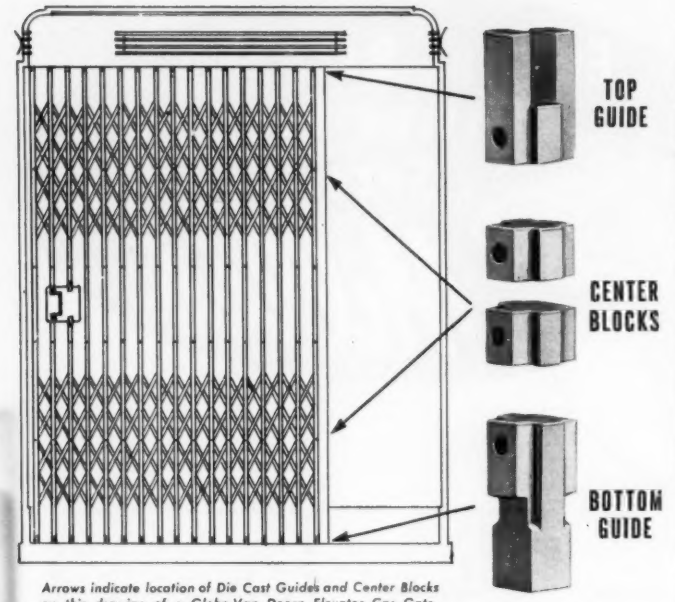

Arrows indicate location of Die Cast Guides and Center Blocks on this drawing of a Globe-Van Doorn Elevator Car Gate.

DIE CAST Guides and Center Blocks SIMPLIFY FABRICATION OF COLLAPSIBLE GATES FOR ELEVATOR CARS—

Some years ago the Globe-Van Doorn Corporation of Milwaukee sought ways and means to speed up and simplify fabrication of the collapsible gates for its elevator cars . . . and, if possible, to reduce costs at the same time.

One move which helped to accomplish all three objectives was the die casting of the top-and-bottom guides as well as the center blocks, which are vital units in the gate assembly. Four such units (2 guides and 2 center blocks) are riveted in place in each upright channel . . . and there usually are at least 16 uprights in each gate.

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FILLING THE DIE

We are very interested in the article of your July issue on die cast aluminum windows, and would appreciate any information regarding the design of the die, especially how the trouble was overcome.—D.L.H. (England)

Unfortunately, we do not know this detailed information, but are turning this inquiry over to the manufacturer who may be willing to supply some of this information.—Ed.

COMMERCIAL DIE CASTING MACHINES

We are looking for an article summarizing the specifications of various commercial die casting machines. I believe the article appeared some time within the last two or three years in your publication which we receive but we don't seem to be able to locate it in our office now.

Can you give us assistance in this matter? If you are familiar with the article please send us a copy of same, invoicing us for the charges involved. —J.L.H.

The article to which you refer is undoubtedly the one by William During, vice president of Precision Castings Corp., included in our October and November issues of 1950. This article, printed in two parts, is called "A Comparison of Commercial Die Casting Machines". Copies have been forwarded.—Ed.

DIE CASTING INDUSTRY MEETING

I would appreciate it very much if you would inform me whether or not the Die Cast Industry holds an annual convention. If so, please send me some information concerning them.—E.W.

The American Die Casting Institute, an organization of contract die casters, holds an annual meeting in Chicago at the Edgewater Beach Hotel. The sessions this year will be held September 18-19. For further information contact David Laine, secretary, American Die Castings Institute, 366 Madison Ave., New York 17, N.Y.—Ed.

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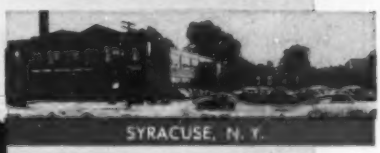

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OFFERED IN THIS MONTH'S ADS

NOTE: Circle numbers on the enclosed postcard to indicate literature, samples or trial services you wish to receive.

No. 3. DIE CASTING, machining, painting and plating facilities of the Admiral Die Casting Corp. are shown in a bulletin offered by the company.

No. 5. "WE'RE GEARED FOR YOUR DEFENSE NEEDS" is a booklet explaining the Advance Tool & Die Casting Co.'s facilities for producing die castings.

No. 23. THE MODEL 400 DIE CASTING MACHINE is described and illustrated in bulletins offered by the Cleveland Automatic Machine Co.

No. 31. SAMPLES OF TINY DIE CASTINGS and bulletins covering production facilities are offered by the Gries Reproducer Corp. This company specializes in very small zinc die castings.

No. 38. THE INVESTMENT CASTING PROCESS is described and explained in a booklet available from the Investment Casting Co.

No. 41. DIE CASTING MACHINES made by the Kux Machine Co. are shown and described in a catalog offered by the company.

No. 44. LITERATURE AND DESIGN INFORMATION on aluminum and magnesium die castings are available from Litemetal Dicast, Inc.

No. 46. FILTERS FOR HYDRAULIC SYSTEMS are described in Folder 105, offered by the Marvel Engineering Co. These filters have no moving or wearing parts.

No. 50. EQUIPMENT FOR DIE CASTING made by the Miller-Taylor Tool Co. is illustrated and described in literature offered by the company. The company makes zinc and aluminum die casting machines in several sizes.

No. 51. MELTING KETTLES, HOLDING POTS and other equipment for handling molten non-ferrous metals is illustrated and described in Catalog No. 101, offered by the C. H. Milles Foundry Co.

No. 60. "HOW TO DIMENSION PRINTS FOR DIE CASTINGS" is

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Fresh Oil FED UNDER PRESSURE BY THE MEASURED DROP

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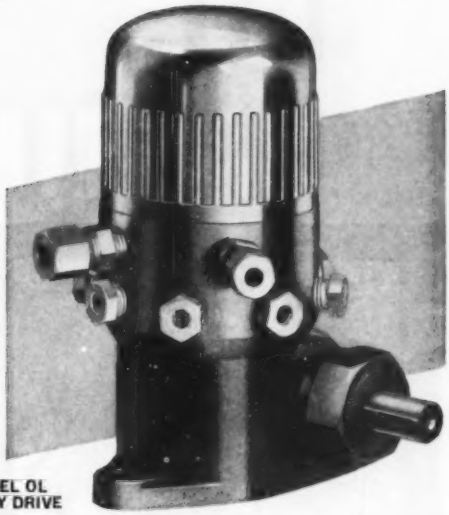

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IN ZINC AND ALUMINUM

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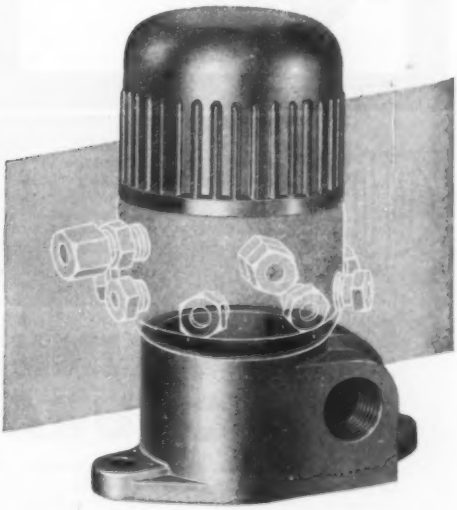

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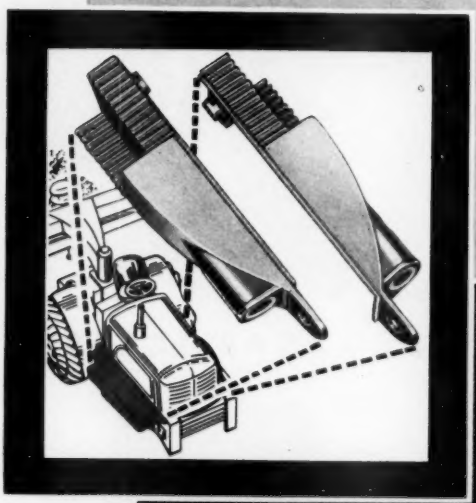

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CINCINNATI DIE CASTING COMPANY

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the title of a booklet offered by the Newton-New Haven Co. The booklet gives detailed instructions for guidance in dimensioning die casting drawings.

No. 63. "POWDERED METAL IN YOUR PRODUCTION PICTURE" is the title of a booklet offered by the Powdered Metal Products Corp. of America. The company makes gears, bearings, electronic components and small assembly parts of sintered metal powder.

No. 78. FURNACES FOR MELTING ZINC AND ALUMINUM alloys are described in literature available from Stroman Furnace & Engineering Co. These furnaces are built in both dip-out and tilt models in capacity ranges from 200 to 14,000 pounds.

No. 80. EXAMPLES OF DIE CASTINGS in zinc and aluminum made by the Tri-State Die Casting Corp. are presented in a catalog offered by the company.

No. 82. PHYSICAL PROPERTIES OF ALUMINUM alloys made by U. S. Reduction Co. are given on a slide chart offered by the company. By positioning the pointer under the alloy number, the user can read the information in windows on the chart.

No. 84. INVESTMENT CASTING PATTERNS can be made from styrene on a plastic molding machine. Information on machines designed for this purpose can be obtained from the Van Dorn Iron Works Co.

No. 70. NON-FERROUS FOUNDRY EQUIPMENT including dip-out kettles, ladles and skimmers are illustrated and described in a leaflet available from the Salem Tool Co.

No. 74. PERMANENT MOLD MACHINERY, hand, air and hydraulically operated, is illustrated and described in literature offered by the Standard Machinery Co.

No. 13. INFORMATION ON INVESTMENTS for casting with the lost wax process is offered by Pre-Vest, Inc. This company specializes in the production of investments for ferrous and non-ferrous investment casting.

No. 15. "QUALITY PRECISION INVESTMENT CASTINGS FOR INDUSTRY" explains how plaster mold

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Philadelphia New York

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castings can be used in various industrial applications. It is available from the Atlantic Casting & Engineering Corp.

No. 42. THE LESTER PRESS, a publication designed to disseminate information about the die casting process and die casting machines manufactured by Lester-Phoenix, Inc., will be sent to qualified individuals by the company.

No. 34. DIE CASTING MACHINES for zinc, aluminum, brass and magnesium alloys are described and illustrated in Bulletin 5106, available from the Hydraulic Press Mfg. Co.

No. 71. "MODERN PRECISION INVESTMENT CASTING" is the title of a booklet offered by Alexander Saunders & Co. This company manufactures investment casting equipment and supplies.

No. 14. "A CRITICAL SURVEY OF INVESTMENT CASTINGS" is the title of a booklet offered by the Arwood Precision Casting Corp.

No. 68. MAGNETIC CORES AND PARTS, porous filters and structural parts made of sintered metal powder are illustrated and described in a folder offered by Radio Cores, Inc.

No. 1. A SMALL DIE CASTING MACHINE that will cycle over 1000 times per hour is illustrated and described in literature offered by the A. B. C. Die Casting Machine Co. The machine is intended for use with one and two cavity dies.

No. 17. ELECTROFORMING, a process of metal forming involving the electro-deposition of metal on a form of predetermined size, is explained in a booklet offered by Bart Laboratories, Co., Inc.

No. 49. IMPREGNATION OF POROUS CASTINGS by the Mogullizing system is explained in literature offered by the Metallizing Company of America.

No. 89. BURNISHING BALLS AND SHAPES and suggestions on how to use them are contained in a catalog issued by the Abbott Ball Co. The company manufactures burnishing shapes made of bearing ball steel in many shapes and sizes.

No. 90. ENAMEL FILLING OF RECESSES in die cast parts is illus-

IPCo Precision INVESTMENT CASTINGS

Reduce machining costs with top quality I.P.C. Co investment castings — precision cast to keep your finishing operations to a minimum.

I.P.C.Co has the experience to furnish quality castings to meet large or small production requirements.

Consider the advantages of I.P.C.Co investment castings.

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  Less restricted—complicated and odd shapes are easily produced.

- Materials

  Choice of metals available range from non-ferrous group to carbon and high alloy steels, stainless, tool steels and special alloys.

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  Tolerances comparable to machined parts—plus or minus .0025″ per inch.

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  Eliminates machining—permits complicated odd shaped designs—utilize hard-to-machine materials.

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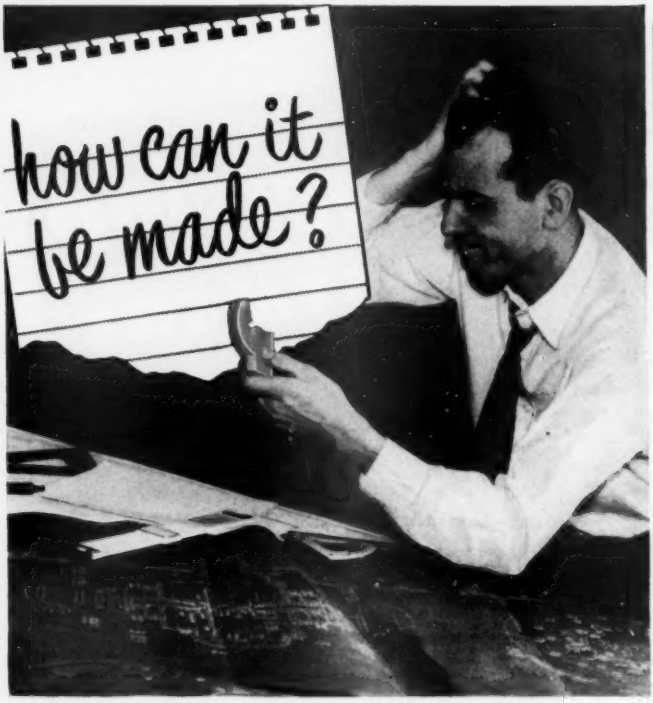

Intricate parts and precision components

***can be* ELECTROFORMED**

Write Dept. PM-9 for copy of Electroforming Applications and Procedure

If the radio frequency componeni you need cannot be made by conventional methods or is difficult and costly to manufacture, the possibilities are it can be made by electroforming.

Electroforming can produce parts of intricate design, accurate interior dimensions and with high interior surface finish up to 5 micro-inch. Combinations of metals may be used such as silver, gold, copper, nickel and iron for specific applications such as conductivity, strength and corrosion resistance. Dimensional stability is easily obtainable whereas it would be impossible to hold dimensions by any other method.

ELECTROFORMING is the manufacturing of an article by the electrodeposition of metal on a form of predetermined size, shape, accuracy and finish. We welcome the opportunity to discuss your problem, no matter how difficult it may seem.

BART LABORATORIES CO., INC.
227 Main St. Belleville 9, N. J.
Pioneers in Precision Electroforming

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trated and described in literature available from the Acromark Co.

No. 91. "ADVANCED BARREL FINISHING" is the title of a booklet offered by Almco Division, Queen Stove Works, Inc. The booklet gives details of the Supersheen method of controlled barrel finishing.

No. 92. PNEUMATIC DEVICES AND CONTROLS are illustrated and examples of how they can be used are given in two Bellows Co. bulletins, AV-300 and CL-30.

No. 93. A COMPACT, COMPLETELY AUTOMATIC DRILL HEAD with self-contained air and controlled feed and speed is described in a catalog offered by the Dumore Co.

No. 94. EBONOL-Z, A BLACK COATING PROCESS designed especially for zinc die castings will be applied to sample parts by Enthone, Inc. A check list is also offered.

No. 95. BUFFING WHEELS AND COMPOUNDS and other finishing supplies are illustrated and described in literature available from the Formax Mfg. Corp.

No. 96. SIMULATED PLATED FINISHES are given to die castings with Platelustre, a paint recently marketed by the Maas & Waldstein Co. Literature is available on this product, which may be used to simulate copper, brass or bronze plating.

No. 97. FORMED WHEEL GRINDING, in which the backstand belt idler wheel is preformed to the shape of the part being ground, is described in literature offered by the Minnesota Mining & Mfg. Co.

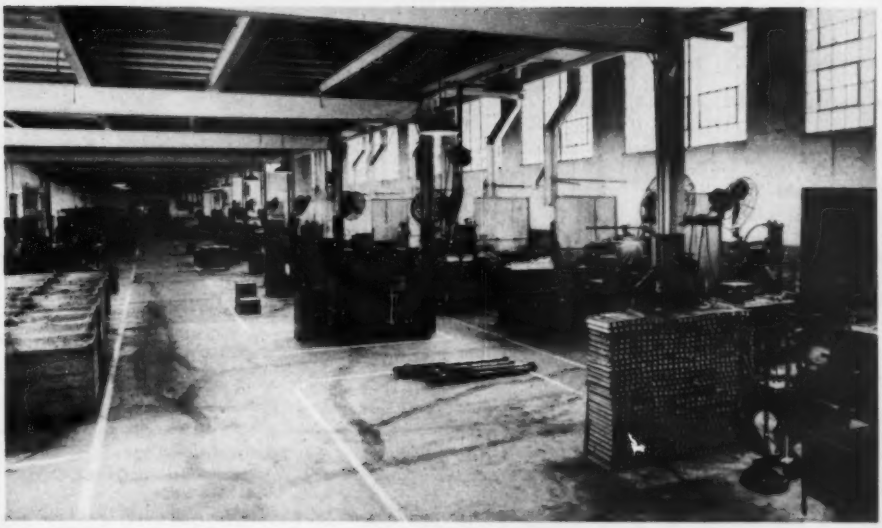
No. 99. BLACK OXIDE COATINGS for iron and steel are the subject of Bulletin MB-3, offered by the Mitchell-Bradford Chemical Co.

No. 100. "NEW METAL CLEANER REMOVES OIL AND RUST IN ONE OPERATION" is the title of Folder F7993, available from Oakite Products, Inc.

No. 101. DETAILS OF THE HYDROHONE PROCESS, a wet abrasive blast cleaning and polishing system usable on die casting dies and other hard metal objects, are available from the Pangborn Corp.

continued on page 103

IMPROVED FACILITIES FOR DEFENSE



Since World War II the facilities of our die casting department have been considerably increased.

This means that as a subcontractor we are better prepared to meet the production demands of the mobilization program.

Send us your inquiries.

PRESSURE CASTINGS, INC.

die castings

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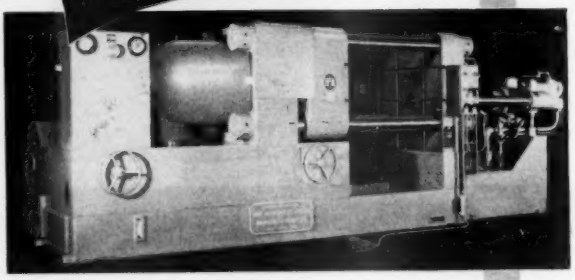
H-P-M's *that Speed Up Die Casting PRODUCTION!*

Whatever your production picture—large or small—there's an H-P-M die casting machine to bring in new profits. Follow the lead of Hoover, Westinghouse, General Electric, Western Electric, Chrysler, Emerson Electric, and many others for new production "highs" with H-P-Ms.

150-A For Small Die Castings

400-A For Big Die Castings



CHECK THESE H-P-M DESIGN FEATURES

THE H-P-M ALL-HYDRAULIC MOLD CLAMP, guided by four strain rods, assures positive mold alignment. Die change-over is simple and fast. Both clamp stroke and pressure are adjustable. Positive overload protection is provided at all times. High speed closing and opening, with automatic slow-down prior to mold contact, guarantees fast, shockless operation.

H-P-M AUTOMATIC CYCLE CONTROL permits maximum production. Manual effort has been minimized. Electric hand switches control mold clamp, hydraulic ejector and core pulls. A single Multiflex timer controls the automatic cycle after metal has been ladled into "cold" chamber. A selector switch is provided for manual operation of entire cycle, if desired.

THE H-P-M HYDRO-POWER OPERATING SYSTEM provides a direct and compact source of hydraulic power. All pumps, valves and controls are built by H-P-M for heavy duty service. Undivided responsibility to the user is guaranteed. Each pump is equipped with convenient volume and pressure controls. Only electric power and cooling water are required to operate these self contained machines.

Write today for Bulletin 5106, or better yet, call in an H-P-M engineer to discuss your particular problems.

SPECIFICATIONS

	MODEL NUMBER				
	150—A	150—Z	400-A-M	400-A-S	400—AV
SIZE OF DIE PLATES	24½x24½	24½x24½	38x38	45x45	36x36
SPACE BETWEEN BARS	15½x15½	15½x15½	23x23	30x30	36x36
DIE OPENS	12	12	16	16	20
MAXIMUM DIE SPACE	28	28	42	42	42
CAPACITY PER SHOT (LBS.)	4 (AL)*	10 (ZN)	12 (AL)*	12 (AL)*	12 (AL)*
NET WEIGHT (LBS.)	13000	16000	40000	44000	33000

*NOTE: These models handle brass and magnesium die castings as well. Complete specifications on request.

THE HYDRAULIC PRESS MFG. CO. HPM **1094 Marion Road • Mount Gilead, Ohio**

HYDRAULIC MACHINERY **PUMPS • VALVES • MOTORS**

Revolutionizing Production with Hydraulics Since 1877

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DIE CASTING

means "happy landings" for a host of production projects

CASE HISTORIES FROM MT. VERNON FILES

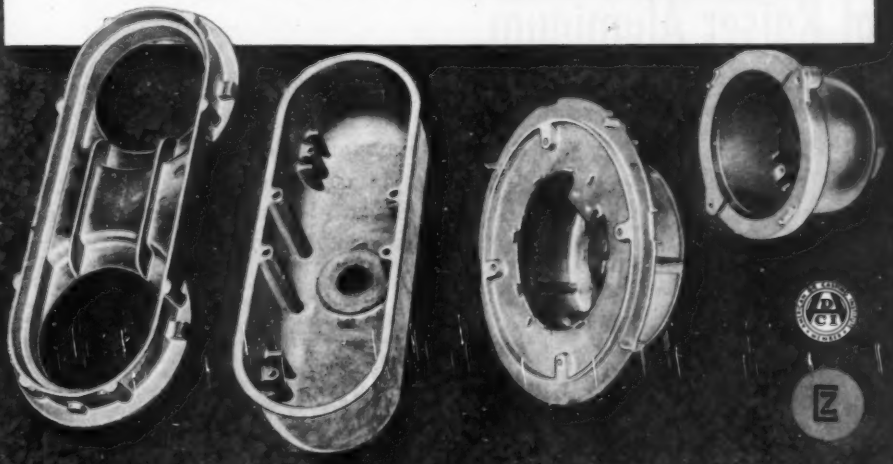
Start to plan a production job, and immediately you must figure out how to "land" on the credit side of the ledger. Get the work rolling, and you must keep within the boundaries of estimated costs at each stage of production.

These are good reasons for considering die casting every time you have to specify a manufacturing procedure. For die casting is a quick, cost-cutting means of producing items for thousands of applications . . . superior products that can be sold competitively.

Says American Gas Accumulator Company, of Elizabeth, New Jersey. "The various die-cast parts made for us by Mount Vernon, for use in our airport runway and obstruction lights, not only help us hold down manufacturing and assembly costs, but contribute importantly to the quality of our products and their successful operation under rugged outdoor conditions."

That's die casting!—fast, economical production; "clean" parts which require little or no machining, and adapt themselves readily to all types of finishing; dependable end products.

Numerous manufacturers have found die casting a "top flight" method for saving time and materials, stepping up output and reducing unit costs. Why not send us your specifications. We feel confident we can show you how to profit likewise.



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Independent Fabricators rely on Kaiser Aluminum engineers for expert technical advice and engineering assistance on any aluminum casting or extrusion problem. This service is immediately available to help you make better use of Kaiser Aluminum.

▶ Aluminum pig specification ingot, extrusion billets. Sales offices in principal cities. Kaiser Aluminum & Chemical Sales, Inc., Oakland, California.

Kaiser Aluminum

A major producer of aluminum pig, specification ingot and extrusion billets

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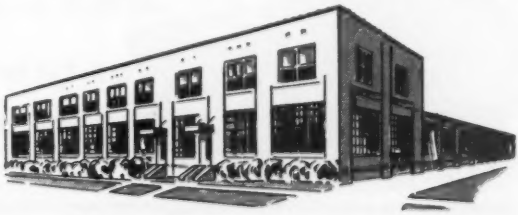
For Zinc Alloy Die Castings That Measure Up To The Highest Standards Consult

Improvement of product quality and reduction of costs is the aim of all management today. Our castings are both competitively priced and outstanding in quality, and can help you build a better product for less. May we quote on your requirements today?

Our Engineers Are At Your Service



SCHULTZ DIE CASTING COMPANY
1810 CLINTON STREET • TOLEDO 7, OHIO

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DIE CASTING— the fastest & most economical method of mass production

Speed of production is the outstanding advantage of the die casting process. Three hundred complex die castings per hour are not unusual, and multiple cavity dies can bring the rate per hour into thousands. Die casting can halve and sometimes quarter the man-hours needed by other methods.

Zinc is the most widely used of all basic materials for die casting. It is strong, easy to machine and reproduces details with great accuracy. Furthermore, zinc can be given almost every type of plastic, paint or metal finish at low cost.

DIE CASTING is the Process • ZINC, the Metal
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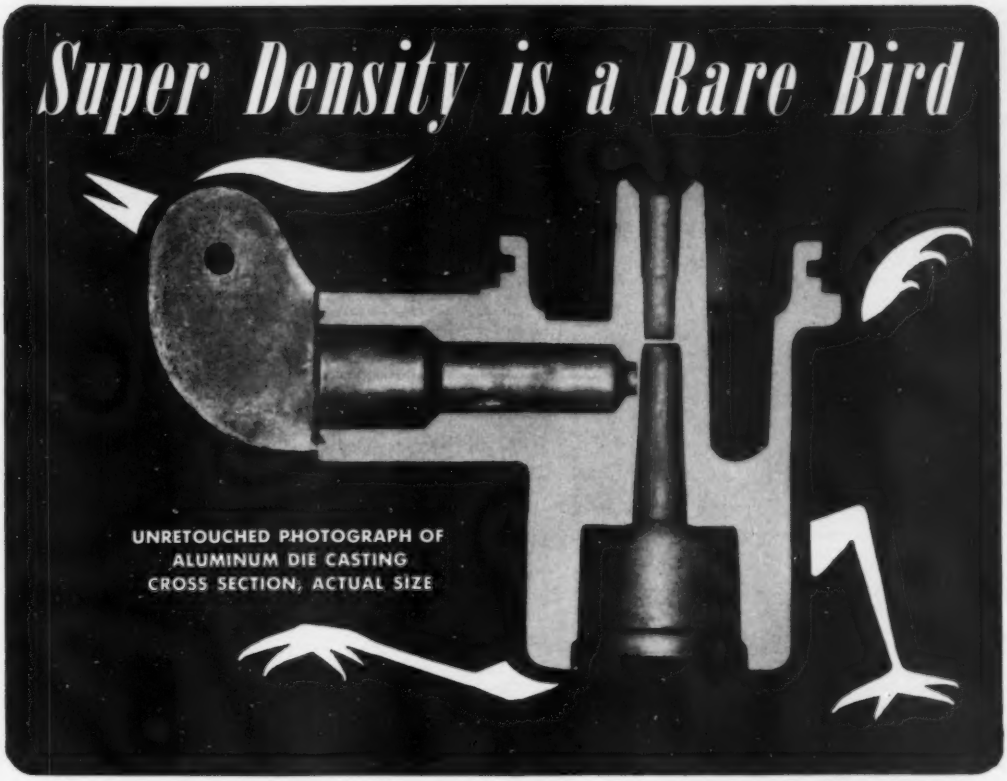
Super Density is a Rare Bird

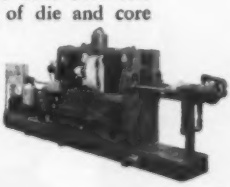


. . . *common to a LESTER*

Here again is an example of how expert die casting technique, intelligent die design and a Lester machine make super-dense aluminum die casting possible. The part is an element of a hydraulic bumper jack, cast by Morton Manufacturing Company, in Omaha, Nebraska, on an early model HP-1-C.

As you can see, the wall thickness ranges from about 3/32" to over 3/8". Besides, the part was required to withstand 4000 pounds of test pressure—*and there have been less than 2% rejects!* Skillful die design and gating, and proper cooling of die and core allow the job to be run at the rate of 120 shots per hour.

Interested in what a Lester-Phoenix Die Casting Machine can do for you? Write Lester-Phoenix or the representative in your area listed below.



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APEX

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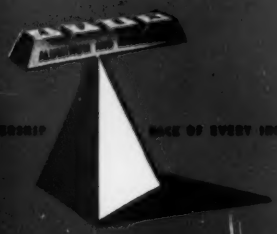
an important factor in production for dependable die
castings—made to exacting specifications—
complete Spectrograph and Quantometer control
from raw material to the finished alloy—
assuring uniform composition—less production
problems—more customer satisfaction
Buy the Best—Buy APEX.



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APEX SMELTING COMPANY

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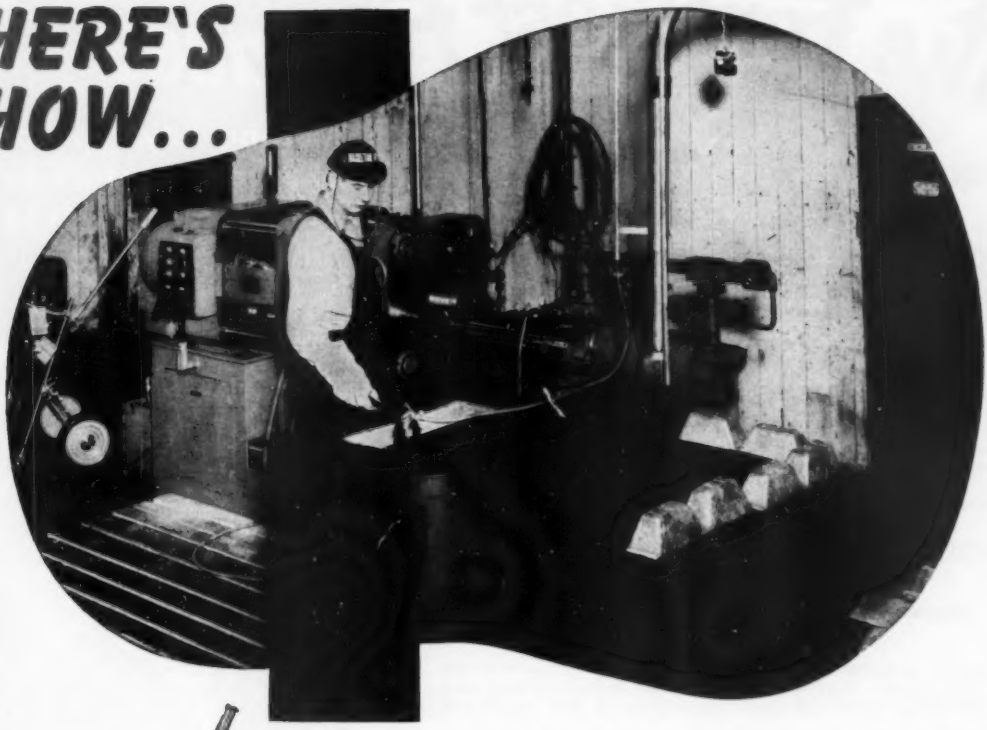

Bag Boy® MANUFACTURERS INCREASED PRODUCTION RATE 5 TIMES

... with the LINDBERG-Fisher 2-Chamber Furnace

Consult your Lindberg-Fisher representative for recommendations on your production problems.

Jarman-Williamson, Portland, Oregon, manufacturers of BAG-BOY—the folding golf cart, utilize the Lindberg-Fisher 2-Chamber Melting Furnace in casting 14 parts for the BAG-BOY. Here's their story as they told it to us:

"Deluxe wheels on our BAG-BOY were becoming a bottleneck. When we used a sand cast wheel, one man on an 8-hour shift averaged 108 wheels—(MACHINING TIME ALONE)! We installed a Lindberg-Fisher 2-Chamber induction furnace as a running mate to our H.P.M. die casting machine. Management policy of buying the best for the job has already paid off—the nine-inch wheel is hitting the assembly line at the rate of 100 an hour. Using a 1¼ lb. shot at a temperature of 1180°F, rejects are less than 5%. We're running 180 lbs. of metal through the furnace an hour (including trimmings, scraps, etc.) with no appreciable temperature variation from the necessary 1180°F! This keeps our unit operating at peak performance. The operator does not depend on test shots or 'feel'.

"As our operation has been running for only a short time it's too early to set up operation cost figures, but we do have some interesting facts: 1) Production rate is five times greater than the previous method; 2) During the weekend idling period, the furnace holds 500 lbs. of aluminum molten for 62 hours on 456 KW, which in Portland costs $4.62; 3) In one day, we charged 1440 lbs. of metal—and removed it at the rate of 3 lbs. per minute from the ladling side—no temperature variation could be noted; 4) We get a high percentage of good castings with comparatively inexperienced help. Our two operators made their first shots on this machine—within 30 minutes good castings were on their way to the production line. To a great extent this is attributable to the constant temperature maintained by our Lindberg-Fisher; 5) Our furnace is within arms reach of the shot well, allowing easier, smoother operation. This is possible only because of the extremely low heat loss from the furnace, which adds materially to the operators comfort and efficiency.

This sums up the fact that to date we are enormously pleased with our purchase. The Lindberg-Fisher induction furnace is proving all that was claimed for it by its representatives."

LINDBERG-Fisher MELTING FURNACES

LINDBERG ENGINEERING COMPANY • 2463 West Hubbard Street, Chicago 12, Illinois

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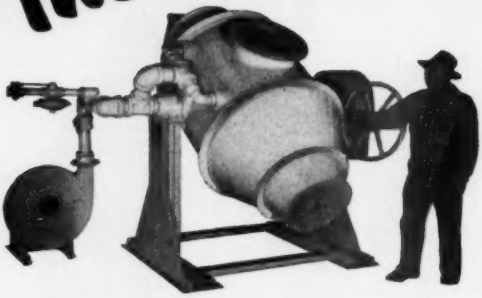
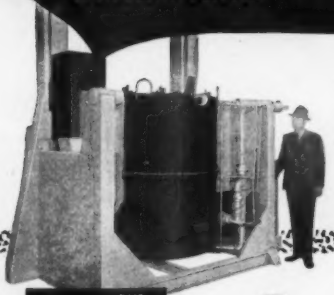
The Foremost Furnaces

for Melting any type of Non-Ferrous Metals in Foundries, Die Casting and Permanent Mold Plants



STROMAN MODEL "BFC" HAND TILT BARREL TYPE MELTING FURNACE FOR ALUMINUM

Featuring "Tangential Firing" which produces a most efficient combustion condition, creating a melting atmosphere that keeps metal loss and dross accumulation at a minimum. Charges through the top or rear door which is also used for drossing metal and cleaning the furnace. Built in 500 lb. capacity and larger. Oil or gas fire.

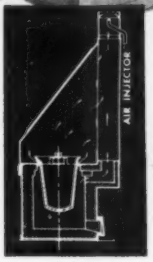


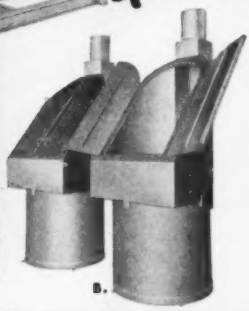
A.

STROMAN MAGNESIUM AND ALUMINUM MELTING AND HOLDING FURNACES

A. Hydraulic Tilt Magnesium and Aluminum melting furnace handling from 500 to 3000 lbs. of aluminum. Incorporates the famous Stroman Stationary Lip Pour, which creates a constant pouring arc at any desired pouring speed. Saves time and metal.

B. Stationary Super-Heating or Melting Furnaces, Type S. F. Designed to deliver the correct super-heat to magnesium after it has been melted in larger furnaces, and before it is poured into the molds. Can also be used for breakdown or holding. They have all safety features. Are available for cast steel pots or fabricated steel pots. Furnaces may be equipped with hoods if so desired, for the venting of combustion and other gasses. Write for bulletin No. 100.





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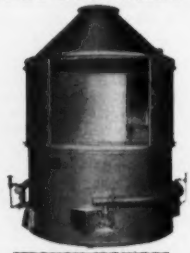

STROMAN IRON POT MELTING FURNACES FOR ZINC OR ALUMINUM

These furnaces are highly recommended as breakdown furnaces for zinc and aluminum die casting and permanent mold plants. They also excel as holding furnaces. They can be supplied either with or without hoods to exhaust fumes and heat. Their construction causes longest pot life and lowest fuel costs. Choice of automatic or manual controls and oil or gas fire. Capacities from 212 to 14,000 lbs. zinc.

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STROMAN HAND TILT CRUCIBLE MELTING FURNACE FOR BRASS, BRONZE, ALUMINUM AND OTHER ALLOYS

Capacities from No. 40 to No. 500 Crucible. Most efficient in operation. Rugged construction assures longest life and trouble-free operation. Oil, Gas or Combination Fire.

Write for Bulletin No. 105

STROMAN TYPE "MC" ALUMINUM DIP-OUT REVERBERATORY FURNACE

Bath capacity from 500 to 10,000 lbs. Aluminum

A combination of breakdown and holding furnaces makes this the most economical furnace ever designed for aluminum melting. It can be used for melting, holding, alloying, fluxing, for either casting or producing ingots. Cold metal does not reach the molten bath. Hot metal is always available for dipping. No iron pots or crucibles to buy. Oil, gas or combination oil-gas fire. Complete automatic controls are available if desired.

WRITE FOR COMPLETE CATALOGUE ON ALL TYPES OF FOUNDRY EQUIPMENT

STROMAN FURNACE & ENGINEERING CO.

DIVISION OF

THE PETERSEN OVEN CO. • 9900 FRANKLIN AVE. • FRANKLIN PARK, ILL.

Teamwork Starts with a Huddle!

WHEN processing your order through the Parker plant, the first objective is complete understanding. In this initial meeting all details of materials, design, die-making, production and testing are carefully worked out. Here is decided how to best solve the problems which are peculiar to **your** requirements. Each job going through here is carefully analyzed before work is started. This is where Parker's half century of experience and know-how begins to pay off for you.

Consult with a Parker representative on your next die-casting requirement.

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And when you think of Die Castings **- - THINK OF**

Parker White-Metal Company • 2153 McKinley Ave. Erie, Penna.

PARKER ALUMINUM *and* ZINC *Die Castings*

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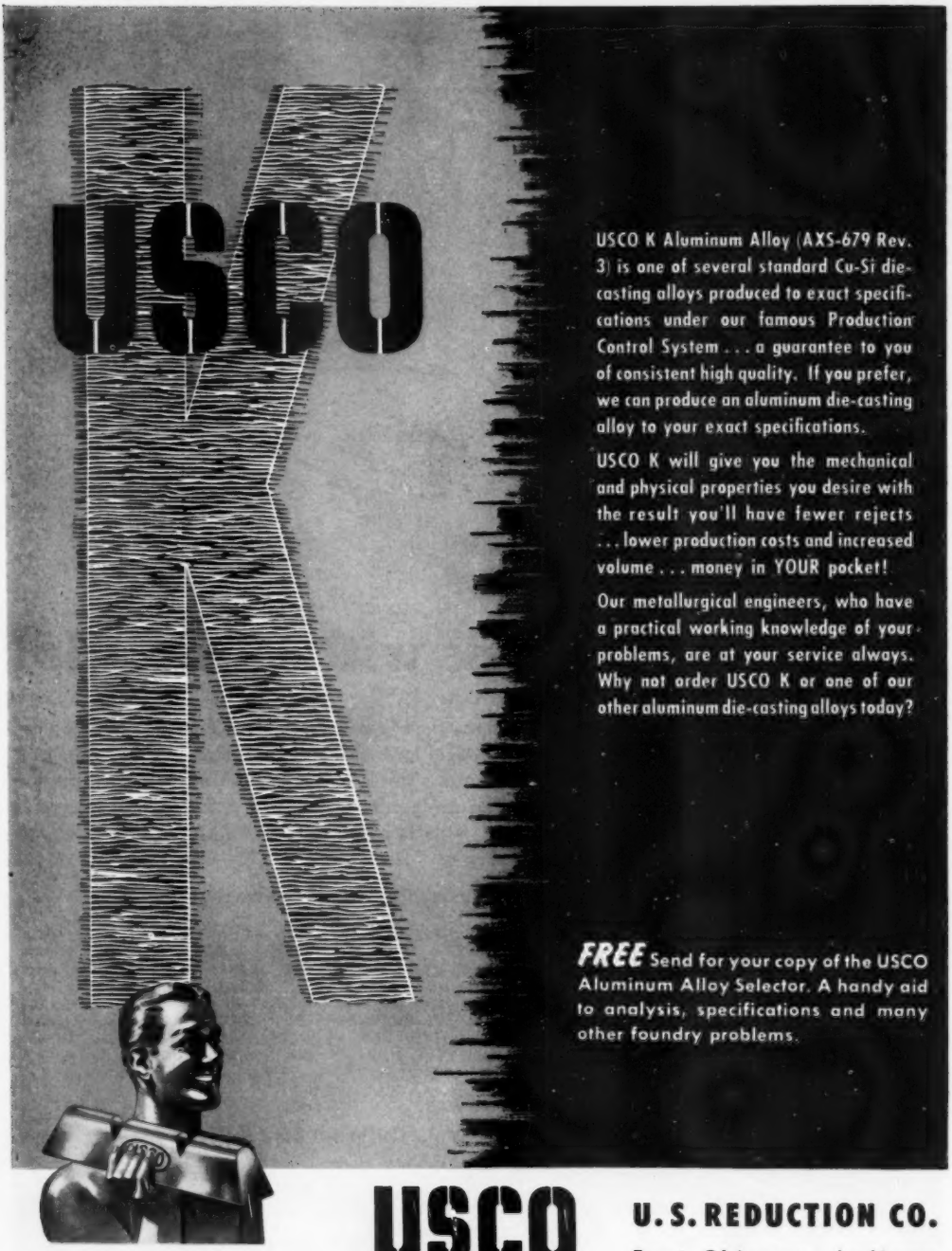

USCO K Aluminum Alloy (AXS-679 Rev. 3) is one of several standard Cu-Si die-casting alloys produced to exact specifications under our famous Production Control System . . . a guarantee to you of consistent high quality. If you prefer, we can produce an aluminum die-casting alloy to your exact specifications.

USCO K will give you the mechanical and physical properties you desire with the result you'll have fewer rejects . . . lower production costs and increased volume . . . money in YOUR pocket!

Our metallurgical engineers, who have a practical working knowledge of your problems, are at your service always. Why not order USCO K or one of our other aluminum die-casting alloys today?

FREE Send for your copy of the USCO Aluminum Alloy Selector. A handy aid to analysis, specifications and many other foundry problems.

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AJAX Induction Furnaces—

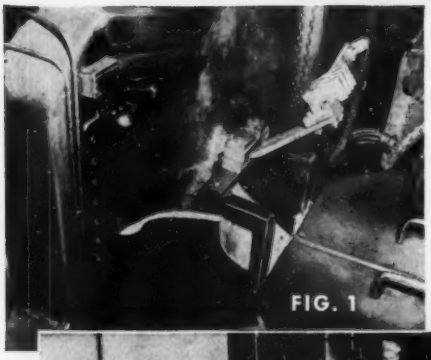
FIG. 1

help HOOVER to cut die-casting costs by efficient melting and pumping of Aluminum

Case History

COMPANY: The Hoover Company, Kingston-Conley Division, Cambridge, Ohio, plant.

PROBLEM: To conserve scarce copper supply by use of aluminum as a substitute.

To cut die-casting costs in the manufacture of squirrel cage induction motor rotors without sacrificing performance characteristics.

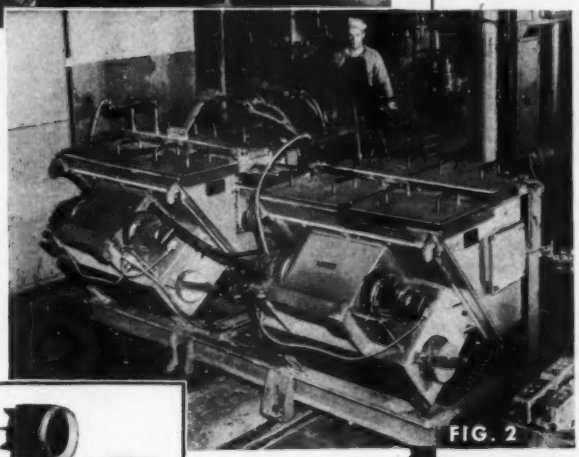
FIG. 2

SOLUTION: Installation of the LOEWY-HYDROPRESS die-casting system, in which several sizes with various end ring designs are made in same die by simple change of inserts. AJAX INDUCTION FURNACE AND ELECTROMAGNETIC PUMP used to melt and pump high-purity aluminum. Low frequency induction principle with precise controls keeps metal at constant temperature. Automatic electromagnetic pump discharges exact amount needed to fill die, eliminating hand ladling.

RESULTS: Combined melting and die-casting set-up so excellent that the Hoover plant converted completely to aluminum die-cast type within 2½ months.

FIG. 3

Fig. 1 shows nozzle of AJAX electromagnetic pump discharging metal into cold chamber of die-casting machine

Fig. 2 shows AJAX melting furnace and electromagnetic pump installed in front of die-casting machine

Fig. 3 shows Hoover squirrel cage aluminum cast rotors

AJAX ENGINEERING CORP., TRENTON 7, N. J.

AJAX TAMA-WYATT

INDUCTION MELTING FURNACE

AJAX ELECTRO METALLURGICAL CORP., and Associated Companies
AJAX ELECTROTHERMIC CORP., Ajax Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., INC., The Ajax Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax Wyatt Induction Furnaces for Melting

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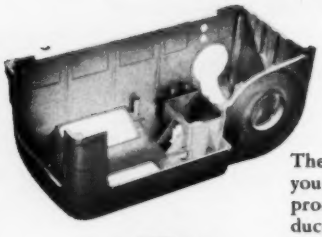
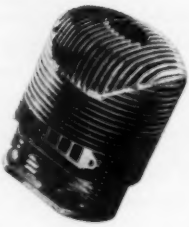
producing **BIG** ones?
or small ones?
using various types of alloys?

all your requirements for profitable die casting can be met with the

Model 400 CLEVELAND
Die Casting Machine



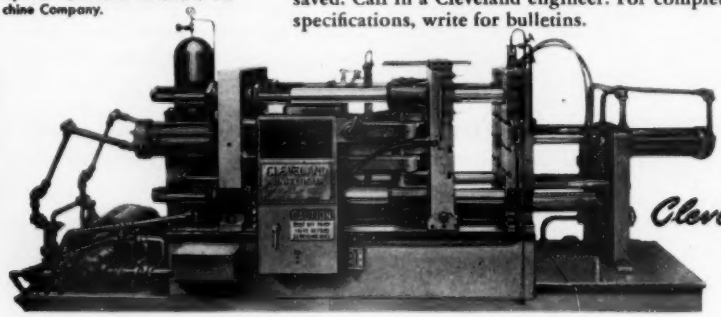


The Model 400 Cleveland Die Casting Machine will give you precision quality castings at a highly profitable rate of production. Castings may range in size from tiny parts produced in multiple cavity dies, to single castings weighing as much as 16.1 lbs. in zinc, or 7.5 lbs. in aluminum. *Universal* in design, the Model 400 can be quickly converted from zinc, tin or lead casting to aluminum, magnesium or brass casting, by changing the hot metal end.

Cleveland design gives you easy access to dies; ample die area; sure-fire shot mechanism; rapid, positive core pull and ejection; safe and simple control—either manual or automatic. Heavy, rigid construction and massive toggle linkage lock dies with tremendous pressure. Cleveland's high injection speed and pressure produce sound, dense, *hardware finish* castings. Dimensions are held to close tolerances; cored sections are precision-cast.

The nation's leading producers of die castings rely on Cleveland dependable performance—for around-the-clock production! You should find out now how Cleveland machines can improve *your* die casting production with money saved. Call in a Cleveland engineer. For complete machine specifications, write for bulletins.

Cleveland Model 400 High-Pressure Hydraulic Die Casting Machine. 36" x 38" die plates; 400 tons locking pressure. Die casting machines of smaller capacities are also produced by The Cleveland Automatic Machine Company.



Remember
Clevelands Cut Costs

THE CLEVELAND AUTOMATIC MACHINE COMPANY

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SALES OFFICES: CHICAGO
CLEVELAND • DETROIT
HARTFORD • SO. ORANGE

Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

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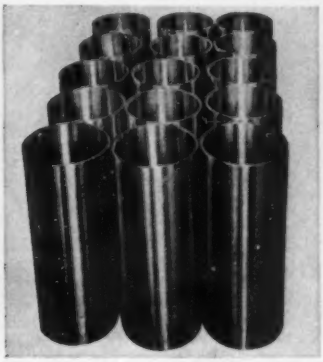
for strong, hard, heat- and corrosion-resisting Castings

—consider MONEL, NICKEL and INCONEL

SAND CASTINGS



CENTRIFUGAL CASTINGS

PRECISION CASTINGS

If you want castings that must show long life—even under severe corrosive, thermal and mechanical conditions—investigate problem-solving Monel, Nickel and Inconel.

These Inco Nickel Alloys resist corrosion by most acids, alkalies and salts; they have the hardness needed to withstand abrasive and erosive attack; they are strong at high temperatures, at low temperatures.

"S" Monel's high hardness and resistance to galling make it a favorite material for all wearing surfaces where erosion is a factor. "H" Monel is used where better ductility is required on mildly abrasive applications.

Inco will supply the castings to your order from our own foundry at Bayonne, N. J. This foundry is maintained as a service to users of Nickel alloys.

Here, your order gets *double* expert attention. Attention by expert foundrymen; attention by foundrymen who are experts in casting high-Nickel alloys.

At present much of Inco's production is being diverted to defense and you may not be able to get immediate delivery. However, our expert foundrymen are always ready to help you with your special casting problems, whether they be sand, centrifugal or precision.

Pass the details along to Inco at the address below. Let us work it out with you to see how economically it can be solved by use of high-Nickel alloys.

PRECISION CASTINGS ARE PRODUCED IN THESE METALS

Monel®
"H" Monel
"S" Monel
Nickel
Inconel®
Ni-Hard®
Ni-Resist®
Stainless Steels
SAE, AISI, NE Steels
Tool Steels
Copper-Base Alloys
Cobalt-Base Alloys

EMBLEM OF SERVICE
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TRADE MARK

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Think of Inco for Castings in durable metals

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Hoover is Geared for Complete Die Casting Service

It was back in 1922 that Hoover went into the manufacture of die castings, applying the Hoover urge for quality—which has won leadership in the electric cleaner field—to the exacting requirements of this industry.

Today, Hoover is supplying many leading companies with aluminum and zinc die castings made to their particular requirements. Accelerated armament demands have greatly increased Hoover die casting experience and facilities.

More than ever is Hoover geared to give complete service, including:

Experienced engineering service. The facilities of Hoover chemical, metallurgical and X-ray laboratories, and a modern, completely equipped machine shop. A closely coordinated organization geared for prompt service.

These are advantages of Hoover's die casting service, now available to industry. Manufacturers who are interested are invited to write us for further details.

HOOVER

Specialists in the field of Die Castings

THE HOOVER COMPANY

Die Castings Division • North Canton, Ohio

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A STEP FORWARD WITH

PRECISION METAL MOLDING

FOR many years, Die Castings magazine has concentrated on the job of disseminating information concerning the design and application of die cast parts.

However, when the design engineer is developing products in which there are small-to-medium sized metal parts, he finds that he has a choice of several methods by which metal can be molded into accurately dimensioned shapes. Each of these processes has its advantages and proper use; none of them is a cure-all for every design problem.

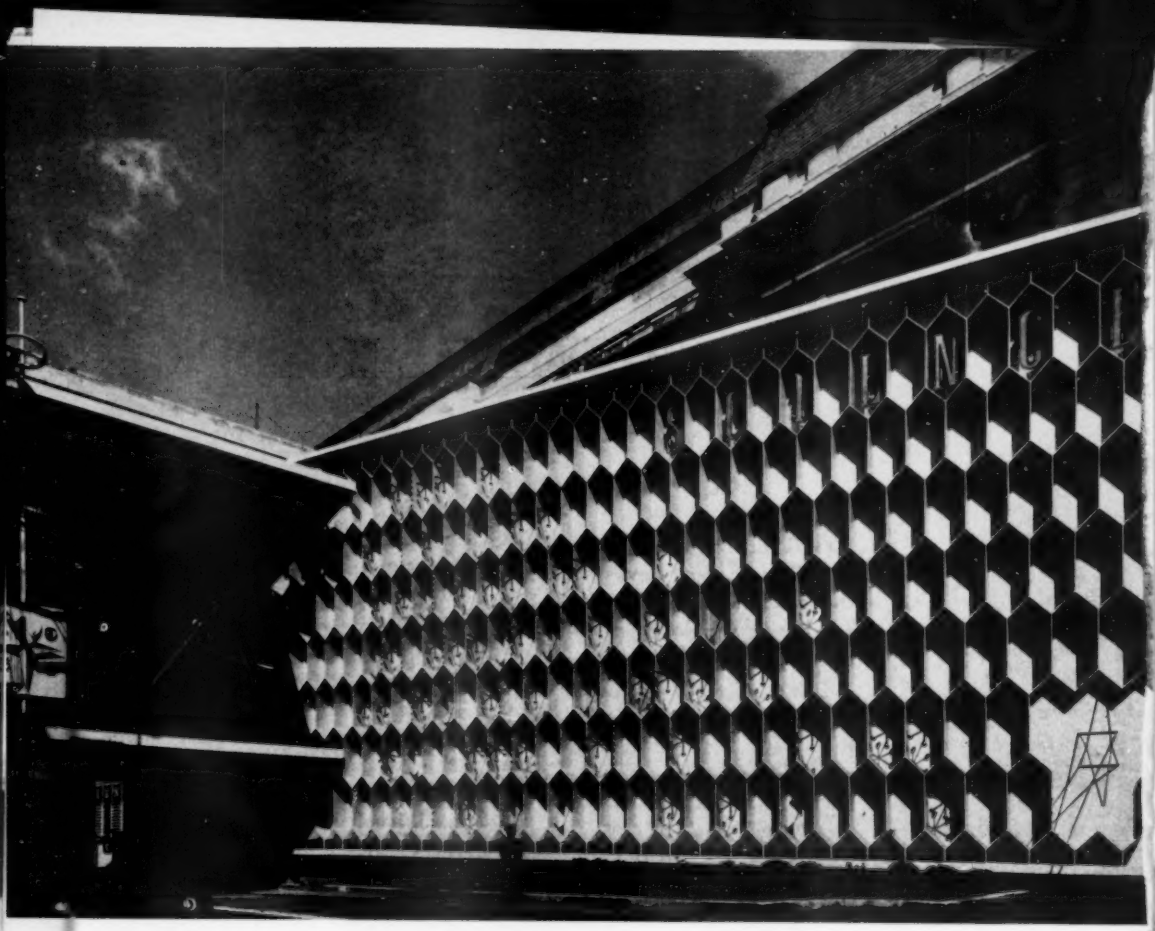
Feeling that there was a need for a single source of information concerning this group of fabricating processes, the editors of Die Castings magazine sent out a questionnaire to a large group of its readers to find out how many of them, in addition to designing or purchasing die castings, are also responsible for selecting and buying permanent mold castings, powder metal parts, investment castings and plaster mold castings.

So conclusive were the results of this questionnaire that it was decided to enlarge the editorial scope of Die Castings magazine to include information concerning powder metallurgy, permanent mold casting, investment casting and plaster mold casting, along with die casting.

Effective with this issue, September 1951, Die Castings magazine becomes PRECISION METAL MOLDING magazine. The staff of the magazine has been enlarged and the size of the magazine has been almost doubled to accommodate the additional articles which will be presented.

By disseminating information concerning all these processes, it is hoped that designers and development engineers will be able to put their fingers on the exact process which will best serve their purposes. PRECISION METAL MOLDING will give this information in several ways: by presenting case histories, by technical articles on design factors, by listing properties and limitations of various metals and alloys available, by recommending "do's and don'ts" in designing and by supplying what amounts to a directory of fabricators and suppliers of materials and equipment through its advertising pages.

Irving B. Hexter



PRE-FABRICATED CONSTRUCTION:

locking parts of new system are made by *Die Casting*

By ALAN T. CAZIER, Associate Editor

PRE-FABRICATED construction, although a boon to the man wanting a full-sized house at a moderate price, has several drawbacks. One of these, standardization, although necessary to take adantage of the reduced labor and material costs resulting from mass production of component parts in a factory, removes individuality from the structure.

When wood is the structural material, this standardization is so complete as to allow little deviation from the basic design. Alterations are so expensive that they defeat the purpose of pre-fabrication. The buyer of the building, therefore, must often be content with a home that differs from those of his neighbors in color scheme only.

One solution to this problem has been developed by a British architect, Robert Henderson. Mr. Henderson's invention is basically an Erector set on a giant scale, with an ingenious system for locking aluminum extrusions together to form joints, beams and bracing members.

The invention has been designated the Keylock system, and is marketed in Great Britain by Robert Building Inventions, Ltd. Aluminum alloy extruded channels are used as a basis for the system. These channels are one inch by one inch in cross-section, and all three faces are perforated every three inches. The channels are sawed to the desired length and extruded end pieces are inserted in the ends to make a solid section. The alloy used for the extrusions has an ultimate tensile strength of 36,000 psi.

This system of construction has several obvious advantages over the typical wood structural fabrication. Probably the most important is that although the complete framework of the structure is fabricated on a mass production basis, with all its attendent cost reductions, the structure itself can take any shape that the builder chooses.

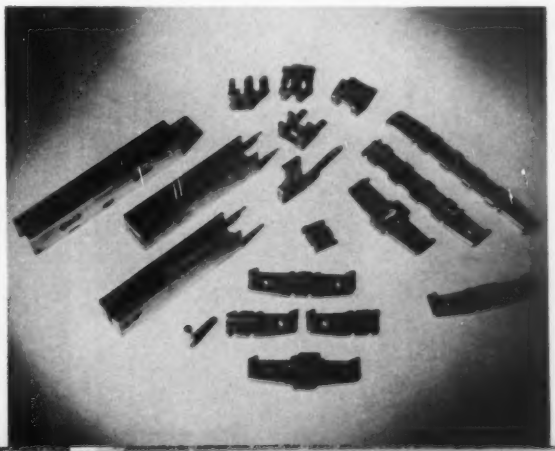
Structures built by this method are limited to a height of four stories, although the greater strength of aluminum as compared to wood, and the fact that beam sections are easily built up, permit rather large unsupported spans.

Large cost savings can also be effected at the building site. The parts are light and easily handled and stored without the use of mechanical handling equipment. The amount of costly skilled labor needed to construct the building has also been greatly reduced. The only tool needed for assembling the framework of a structure with this system is a light hammer, and the use of unskilled labor is made possible by the fact that the system is designed in such a way that improper assembly is impossible.

The number of different parts needed for any type of structure has been kept to a minimum, in order to simplify the contractor's inventory problems. When used in conjunction with demountable cladding this system permits the complete recovery of all materials used in the superstructure when the building is torn down. This feature could save the Armed Forces a considerable amount of money in the construction of barracks, warehouses, aircraft hangars and other temporary structures built in this country and overseas.

The only limitation, other than size, placed on designs utilizing the Keylock system is that all distances must be in multiples of three inches. This is brought about by the three inch modules used in punching out the extrusions. It has been pointed out, however, that the three inch module is not inherent in the system, and

DIE CAST ALUMINUM parts such as the ones shown below are used to lock extruded aluminum channels together to form frameworks for all types of buildings. They were used in the construction of the framework of the 1951 Festival of Britain Science Exhibition entrance, shown on the opposite page. The hexagonal screen, which depicts the chain reaction of the carbon atom magnified 100,000,000 times, is 100 feet long and 45 feet high.



DIE CAST aluminum locking parts permit use of unskilled labor

that any other reasonable distance could be used in punching the channels.

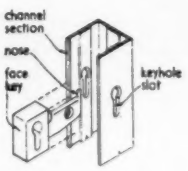
The locking device is the most unusual part of the invention. The locking parts (with the exception of the taper pin) are all die castings, made by the Birmingham Aluminum Casting Co., Ltd. All of the parts are cast in aluminum alloy, and a number of shapes and sizes are available as standard items. The locking device permits rapid assembly without the need of skilled labor, since only a hammer is used in erection. A simple ejector tool is used for disassembly.

The choice of die casting as the method of fabricating the locking parts was a logical one. These parts are required in large numbers and in several shapes. It has been estimated that 1200 die cast parts are the minimum required for a six-room structure. Die casting is the only method which could be used to produce these parts in the required numbers economically.

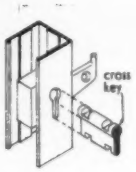
Parts such as these can be produced several to a gate, and are ready for use after a flash trimming operation. The accuracy and smooth surface finish inherent in the die casting process make further machining operations unnecessary.

Assembly is effected by inserting a face key through one of the holes in a channel. A side key is then inserted through the face key and the two holes in the sides of the channel. A four-legged keeper holds the two keys in place and the other channel is then placed over the projecting arm of the face key. A one-inch tapered aluminum pin is driven through the channel end piece and the face key. Since these parts are not pierced concentrically, the tapered pin draws them together to form a rigid joint. A large number of beam sections, joints and other assemblies can be fabricated in this manner; by changing the type of face key used multiple units can be built up.

The accompanying photographs will show the variety and complexity of the structural units that can be formed. This extreme flexibility is a major advantage of the system, since any of the shapes used in construction can be duplicated.

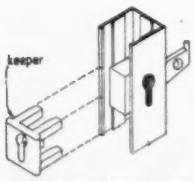


1. face key positioned for insertion in channel

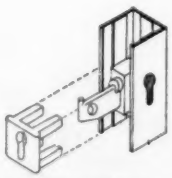


2. face key fully inserted: cross key ready for insertion

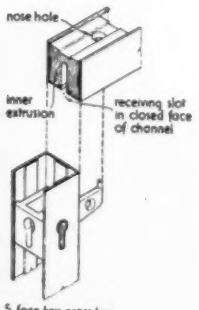
SIMPLICITY OF ASSEMBLY which is characteristic of the Keylock system is illustrated in the assembly diagrams, **right,** showing the construction of a typical joint with die cast elements.



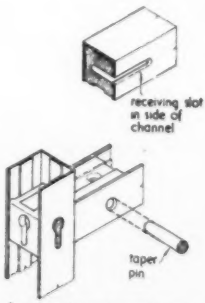
3. face key and cross key in position: keeper ready for insertion.



4. alternative position for face key.



5. face key, cross key and keeper (comprising assembly A) positioned to receive channel



6. second channel located on key: taper pin ready for driving in to lock channels together

Since the weakest point of any framed structure is the joint, this point has been correspondingly strengthened. When the end piece is inserted in the channel, and the face key has been locked in place with the tapered pin, the joint is a solid block of metal.

INTERCHANGEABILITY REQUIRES ±.005 TOLERANCES

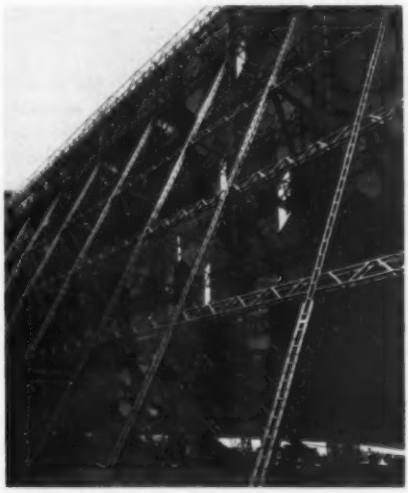
Attention has also been given to the fit between the various locking parts. Tolerances between the channels and the die cast keys are held closely to prevent mismatching, and all keys and channels are interchangeable. Tolerance on the die cast parts has been held to ±0.005, and in order to prevent minimum tolerance keys from forming a loose fit with maximum tolerance channel holes, beads are formed along the sides of the channels producing a snap fit with the keepers.

Die cast aluminum miter blocks are used to form joints in door and window frames and openings. These blocks are cast with outside dimensions that match the inside dimensions of the extruded channels. The miter blocks can be inserted so that the closed face of the channel can be placed either on the inside or the outside of the frame. After the parts are in place, the assembly is riveted together, so that solid extrusions can be used in exposed areas, rather than the perforated channels. This form of miter joint is also used in the United States to form metal windows and doors *(See Die Castings, July, 1951.)*. The miter blocks can be used to connect a gusset plate for truss construction, or to permit diagonal struts in a framed structure.

Outside and inside coverings have been developed to meet not only the special requirements and purpose of any particular building, but in sufficient variety to meet any climatic condition, degree of appearance and finish. In addition it is easily possible to provide for elimination of condensation, a thermal conductivity value of .25 B.T.U.'s or less and freedom from fire

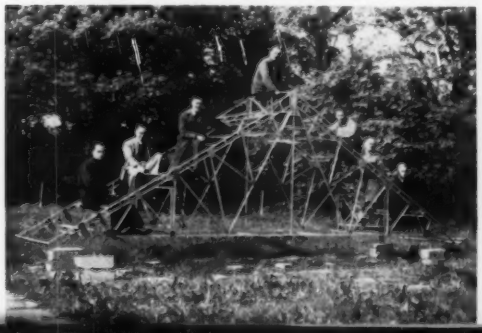
continued on page 77

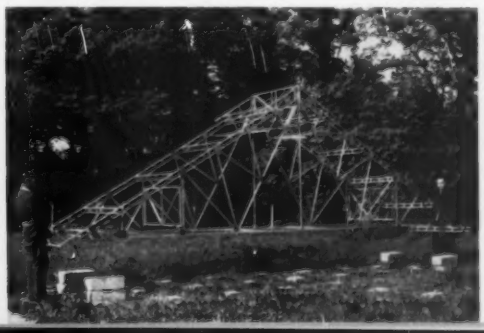
ACTUAL ASSEMBLY of the parts is shown in the photograph above. After the extrusion with end piece is fitted over the arm at right, the tapered pin is driven through the holes to hold the assembly together.

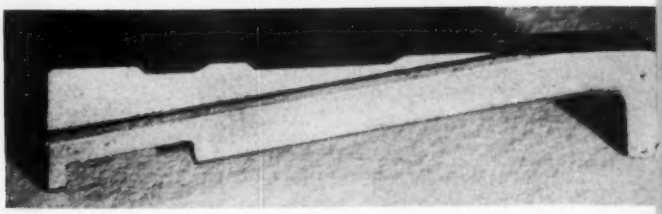


FRAMEWORK for the screen shown on page 32 is illustrated above. The system allows the channels to be built up into large beams.

THE HIGH STRENGTH-TO-WEIGHT RATIO OF ALUMINUM IS ILLUSTRATED IN THESE PHOTOS OF A ROOF TRUSS.







STAINLESS STEEL jaw chucks for a tabulating machine are investment cast to save extensive machining from the solid bar.

SPECIAL MACHINES have several design factors that favor the use of *Investment Casting*

SPECIAL processing machinery capable of doing complex jobs of locating, holding, assembling or finishing, occupies a key position in the American industrial picture. Many special jobs — whether in the fabrication of metal, glass, wood, textiles, paper, ceramics or other materials — cannot be handled effectively with any standard machine or tool.

Around this need for special-purpose machinery has grown an entire industry, devoted to the development and construction of machine tools for specialized jobs. These machines may be custom built for a single plant or location, or they may be "production" jobs for a whole industry group, but still counted in terms of a few dozens or hundreds of units.

Probably no other industry involves higher development and engineering costs in relation to total machine price, nor are there many manufacturing establishments where the amount of skilled labor devoted to machining, finishing, fitting and adjusting represents such a large part of the total cost.

Therefore, it is no surprise that the builders of special-purpose machines have concentrated on finding fabricating shortcuts around much of this expensive labor—to save valuable man hours of milling, shaping, lapping, welding, brazing, boring and other expensive operations.

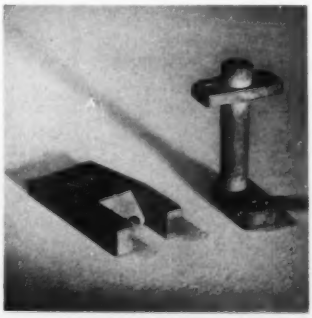
One process which has proved to be a boon to manufacturers of such machines is the investment casting process. It has been seized upon for the production of numerous small-to-medium sized parts of complex shape and exacting tolerance—frequently in alloys which are difficult or impossible to form by any other method.

An outstanding example of the way in which such parts can be utilized by builders of special-purpose machines is in the construction of devices for making electronic tubes for the radio and television industry.

In the various models of tubulating machines produced by Standard Tool and Manufacturing Company of Arlington, N. J., dozens of different investment cast parts in several different alloys are employed.

These machines are used for the progressive steps in the manufacture of electronic tubes. Multiple operations are ganged into an indexing machine whereby

SAVINGS OF ABOUT 30 PERCENT are reported on the post, **right** which had formerly been constructed of three pieces, but is now investment cast from SAE 1045 steel.



the raw glass tubes of different diameter and length are fitted together in accurate relationship, joined, finished to size and prepared for the insertion of filaments.

Numerous small parts, a few of which are illustrated here, are produced for Standard Tool and Manufacturing Company by the Investment Casting Company of Newark, N. J. Most of these parts are supplied in finished or nearly-finished condition so that little or no machining is required.

The support post, shown in Figure 1, is used in a tubulating machine for the manufacturer of miniature glass tubes. It is used to fasten the exhaust tube to the main tube and provide a means for evacuating and sealing.

Originally this small part was fabricated from three separate pieces: a piece of rod stock shouldered at each end, with two flat strips at top and bottom. The top piece had two drilled holes, and the bottom piece had one drilled hole. The need for accurate relationship between top and bottom was such that it involved considerable care in fitting and aligning.

Now this piece is investment cast in a single unitary construction. It comes from the mold with all dimensions to size and holes cast to tap drill size. Alloy used for this piece is SAE-1045 steel. Saving of about 30 percent is reported.

STAINLESS STEEL, STELLITE USED FOR JAW CHUCKS

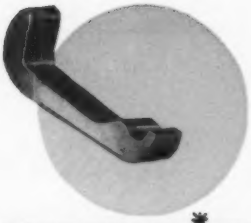
Working parts of such machines are frequently subjected to difficult conditions of wear, abrasion or stress. For this reason, it is an advantage to be able to select the alloy which will best serve the purpose. The range of alloys which can be cast successfully by this process is almost unlimited and includes some with high hardness, poor machinability or weldability — investment casting is the only way by which some of these difficult-to-fabricate alloys can be formed into complex shapes.

Stainless steel and Stellite are two special materials required by parts in the Standard Tool and Manufacturing machinery. The piece illustrated in Figure 2 is an investment cast jaw from a three-jaw chuck which holds the outside of a tube. It is cast in 410 stainless steel for high wear resistance.

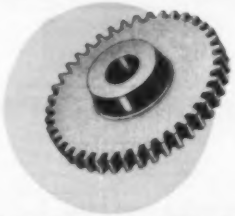
The unusual shape of the part should be observed. This piece was, at one time, hogged out of the solid, which involved some costly machining, as can be judged by the shape of the bevel contour and the close tolerance notches on top. Now, as investment cast, these chucks are ready to install in the machine as received.

A number of different types of chucks and holding fingers are investment cast, some in SAE 1018 and others in Stellite. One set of investment cast chucks holds a piece of round tubing while it is being heated

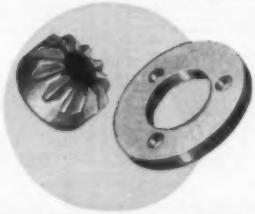
continued on page 84



POWDERMET* PARTS



INCREASE YOUR



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PMP

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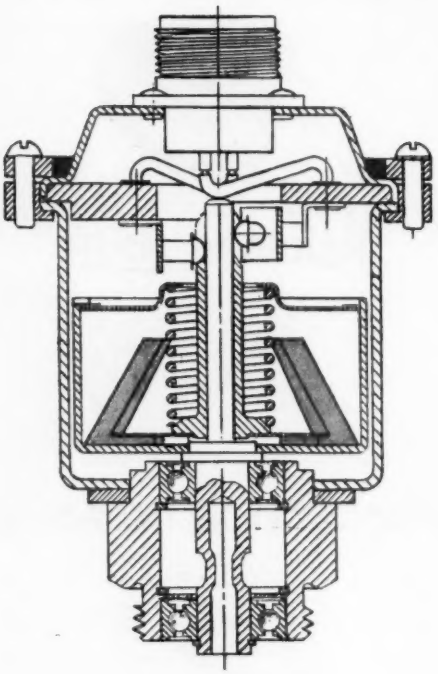
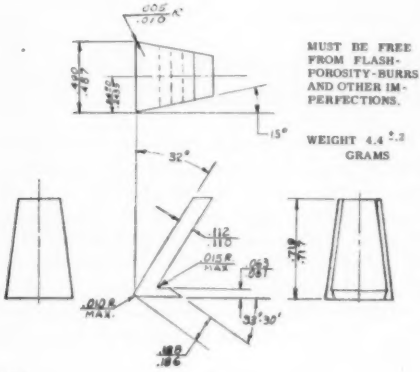
CLOSE WEIGHT

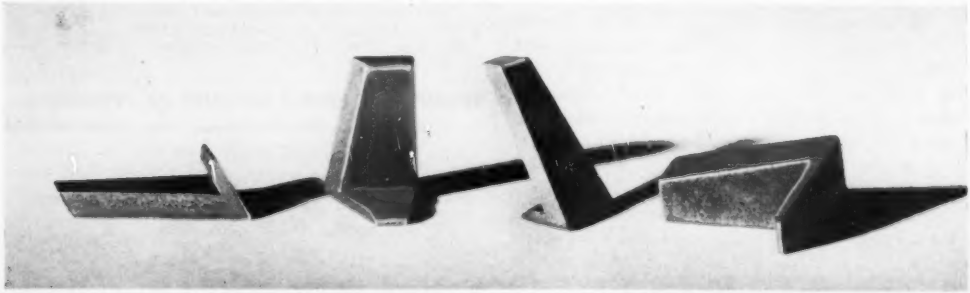
By R. R. ABBOTT
Director of Metallurgy, White Motor Co., Cleveland, O.



IN powder metallurgical work, it is seldom that parts must be held to a given weight within very close limits. When the necessity arises for holding a part to a uniform, controlled weight, and at the same time to very close dimensional tolerances, one of the highly



CONTROL OF WEIGHT within ±.3 gram and greater economy have been motivating factors in the use of powder metallurgy in the manufacture of governor weights, **below.** As can be recognized from the drawings, **above,** these high density bronze parts have no uniform dimension in the direction of applied pressure.



TOLERANCE on truck governor weights

made by *Powder Metallurgy*

exceptional applications of powder metallurgy is bound to develop. The Hydro-Torque transmission governor weights used by the White Motor Company of Cleveland on its line of trucks are examples of such parts.

The unusual shape of these parts lends additional interest to the designer in powder metallurgy. Changes in section, combined with odd angles, and with no uniform dimensions in the direction of applied pressure during forming, all combine to make these governor weights unique.

Reference to the drawings in Figures 1 and 2 demonstrates that most of the dimensions are held to tolerances of ± .001. Such a tolerance, while achievable by powder metallurgical technique is, at the same time, somewhat unusual. By virtue of these small allowances, even the angular dimensions are, of necessity, closely held.

Formerly these weights were made from bronze bar stock. The entire governor was designed to use machined pieces. Substitution of powder parts, if porous pieces were used, would completely upset the operational characteristics of the governor. Therefore, it became necessary to specify that the weights be non-porous.

LOWER COST THAN MACHINED BAR STOCK

In order to assure that the porosity specifications be held, the weight of the finished part is called out by the drawing, with a tolerance of only ± 0.2 grams in one case, and ± 0.3 grams in the case of the larger of the two weights.

While it is admittedly true that specifications in powder metallurgy are seldom as rigid as those required for the governor weights, the fact that pieces are being made in large quantities indicates how well powder metallurgy is suited for this type of part. The motivating factor in the choice of powder metallurgy as a fabricating method is, of course, relatively obvious—low cost production, as compared with machining from bar stock.

The assembly of the governor is of considerable interest, and is shown in Figure 3.

The spherical bushing shown in Figure 4 is another part of unusual interest. This bushing is not an oil-impregnated porous one, but a high-density bronze that must fulfill the functions both of a bushing, and of a structural member.

In the new line of White Motor Company trucks, in order to expose the engine the driver need only step down from the cab, close both doors, and then insert a key in a lock at the side of the cab. By turning this key, the entire cab hinges forward, exposing the engine.

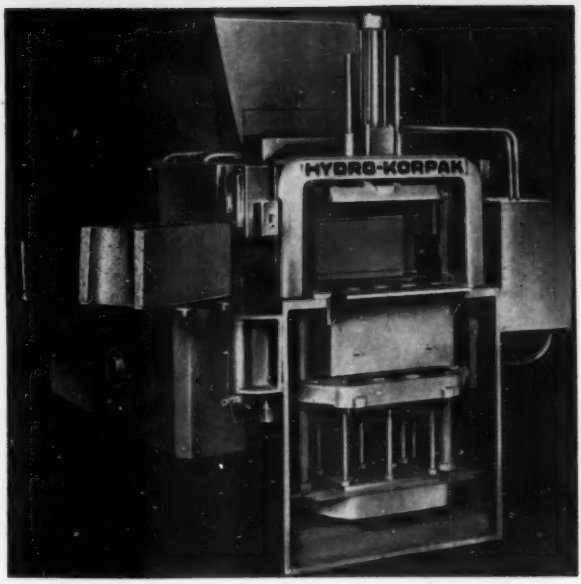
continued on page 93

CONTROL OF MISALIGNMENT required a spherical type bearing; low manufacturing cost at the required accuracy leve ldictated the use of powder metallurgy as the manufacturing method for this bushing on White trucks.

The Makers of HYDRO-KORPAK say:

"MARVEL SYNCLINAL FILTERS *are Standard Equipment . . . and* HAVE GIVEN EVERY SATISFACTION"

*—W. E. Dunn Mfg., Holland, Mich.

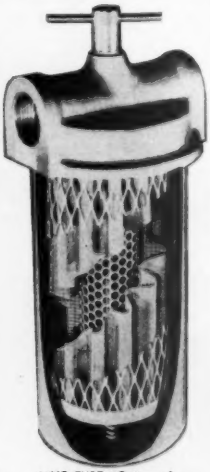


HYDRO-KORPAK is a hydraulic pressure, masonry block making machine. Using sand, cement and cinder material, HYDRO-KORPAK'S hydraulic system must be well protected against damage through entrance of dust or larger particles of such highly abrasive materials. Marvel Synclinal filters, we are assured by the W. E. Dunn engineering department, "have given every satisfaction" in guarding these machines. Marvel protection against injurious foreign matter cuts maintenance costs while permitting the HYDRO-KORPAK to operate with all the productive efficiency built into it by the maker.

FOR ALL HYDRAULIC EQUIPMENT

In any field — under any conditions to which hydraulic equipment may be subjected — however severe — Marvel Synclinal filters are giving substantially longer periods of productive operation at a minimum loss of maintenance time.

SUMP TYPE (Cutaway)



LINE TYPE (Cutaway)

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*As of March 31, 1951

Marvel filters are available in sump and line models, in capacities from 5 to 50 g.p.m. (multiple installations effect greater capacities), and in wire mesh sizes from 30 to 200. Line models operate in any position and may be removed without disturbing pipe fittings. For efficient filtration of non-corrosive liquids in all HYDRAULIC and LOW PRESSURE systems investigate Marvel Synclinal Filters.

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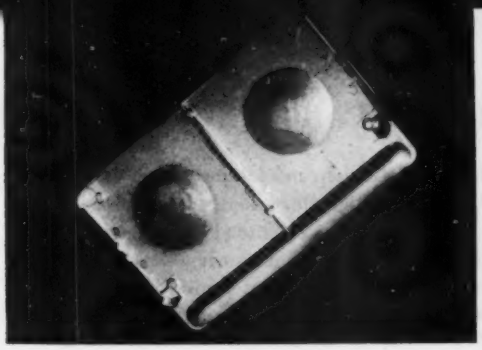


UNIFORM HEAT DISTRIBUTION is one advantage of the aluminum permanent mold griddle, shown from top and bottom sides. Griddle is designed specifically for the Caloric gas stove and fits snugly over the burners, or stores conveniently in a side opening.

OVER THE FLAME an aluminum *Permanent Mold Casting* takes 800 F without blistering.

By JULIUS KLEIN
President, The Caloric Stove Corp., Topton, Pa.

THE Caloric Stove Corp. have been firm believers in the use of a removable griddle in conjunction with the facilities which their ranges offer. For many years these griddles were produced in cast iron. Several years ago they became interested in the possibilities of an aluminum griddle and placed this project with Monarch Aluminum Mfg. Company, Cleveland, Ohio, who offered production facilities in both die casting and permanent mold. The major question to be decided was the choice of one of these two production methods for the most acceptable product.

Careful analysis of the problems involved soon indicated that the permanent mold method of production offered many advantages which could not be obtained otherwise. Foremost was the question of obtaining a dense metal structure at the lightest possible weight that would withstand the temperatures to which the griddle would be subjected under cooking conditions. Because the permanent mold casting is gravity fed and solidifies over a longer period of time than die castings, the metal structure obtained in permanent mold will withstand temperatures ranging up to 800 F. without evidence of blistering or warping.

Warpage obviously is also controlled by careful designing to provide sufficient support through ribbing

continued on page 91

ECONOMIC FACTORS FAVOR P.M.M. PARTS IN MACHINES

In the manufacture of textile machinery, several circumstances favor the use of high accuracy metal parts which can be delivered to the production line in a finished or semi-finished condition. Powder metallurgy and die casting are two such precision metal forming methods specified by Robert Reiner, Inc. in the design of parts for various types of textile machines.

The tooling cost or piece cost which such components bring with them can be more than offset by savings in machining or processing.

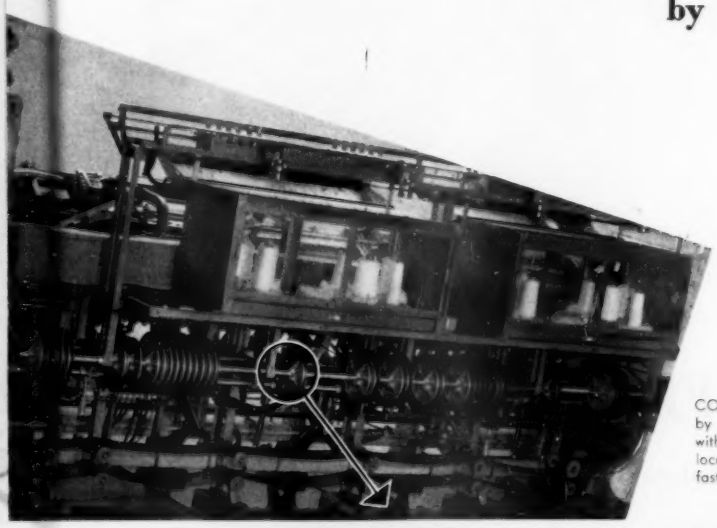
On a production line where the majority of small parts must be machined down from the solid or from rough blanks, it is a definite advantage to utilize the metal forming processes characterized by close dimensional control.

For example, despite the relatively small quantities of any single model or type of textile machine produced annually, there are generally many identical parts on each machine.

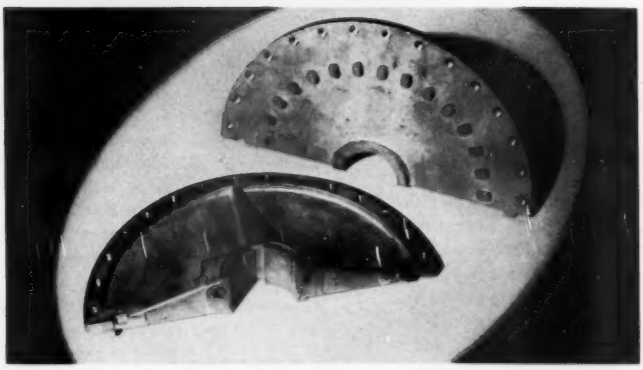
As can be readily visualized, a machine built

CAMS, BEARINGS AND

by *Die Casting* and



CONSTRUCTION OF SPECIAL CAMS is accomplished by using die cast aluminum flanges to hold cam bits with varying lengths. Small radial studs on die casting locate cam bits; cored-tapped holes are used for fastening the bits.



PRODUCED IN RELATIVELYSMALL QUANTITIES

to hold, guide and control the movement of dozens or hundreds of yarns simultaneously consists of a large number of identical systems interconnected and regulated by a master set of cams, links and electrical circuits. Such systems are commonly built with the precision of scientific instruments and consist of many small parts going through repetitive cycles.

Where the introduction of a non-ferrous metal is appropriate and the shape of the part lends itself to the mechanics of forming in a metal die under pressure, die casting can be considered. Where special properties are desired in parts of simple shape, powder metallurgy may be chosen. For piece of unusually complex shape which would be difficult to machine and which require alloys that cannot be die cast, the investment casting process will sometimes do the job.

A few parts selected from current production will illustrate the factors which have determined the choice of fabricating method.

STRUCTURAL PARTS

Powder Metallurgy

FLANGES FOR CONSTRUCTING SPECIAL CAMS

On the hosiery knitting machine illustrated in Figure 1, a series of special cams are mounted on the rotating shaft indicated in circle. The camming surfaces are made to order in accordance with the particular knitting pattern desired on the hosiery. These cams consist of 30 bits mounted radially on a die cast aluminum flange. Each bit is held in place by a machine screw.

The flanges which hold the cam bits are assembled from two aluminum die castings, Figure 2, which fit together over the shaft and are fastened by two machine screws in cored, tapped holes. The two die castings are keyed together at the outer edges to assure alignment and to help in assembling.

The two halves of the flanges are formed in the same die cavity, but using a different plug in the die to form the center portion which fits over the shaft. This allows minimum tooling cost for two individual parts, one of which has the keyway cored in and oversize cored holes for the shanks of assembly screws.

The 15 small lugs for positioning the cam bits are formed as an integral part of the die cast surface and require no machining. In fact, the only machining operations on either half of the flange is tapping.

These flange halves could not be produced from a sheet satisfactorily because the drilling of holes, attaching of small lugs and maintenance of adequate flatness across the surface would be difficult and expensive. Radial ribs on the die castings serve to stiffen these parts. About 30 flanges are used per machine, which is a total of 60 die castings. This quantity has been sufficient to allow reasonable tool amortization.

SPECIALLY SHAPED BEARINGS

In a tricot machine manufactured by Robert Reiner, Inc., there is a need for specially shaped bearing pieces which combine a structural shape with a self-lubricating surface. A guide bar which moves back and forth, requires a series of supporting members on which it can slide freely.

This is accomplished by means of the slide blocks illustrated in Figure 3, which are produced by pressing

TO SUPPORT A SLIDING BAR, specially shaped bearings are produced by powder metallurgy. A self-lubricating, impregnated iron-copper part gives strength as well as a bearing surface.

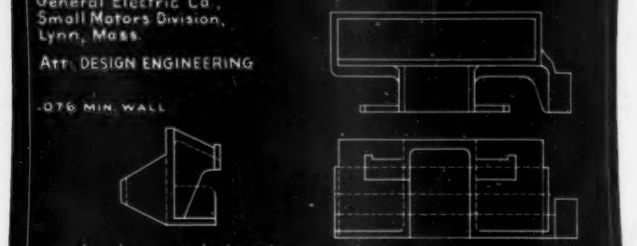
WANTED: closer tolerances, reduced costs

SUGGESTED - BRUSH HOLDER

General Electric Co.,
Small Motors Division,
Lynn, Mass.

Att. DESIGN ENGINEERING

.076 MIN. WALL



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We could produce it to reflect credit
on both companies E.B. Atlantic Casting

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Atlantic was consulted and the recommendations they made on the brush holder design provided more than ample strength. The Atlantalloy process provided the close tolerances and lower cost.

Old brush holder designed by General Electric for use on aircraft generators.

New brush holder designed in collaboration with Atlantic engineers and produced by the Plaster Mold Process.

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CASTING and ENGINEERING CORP.

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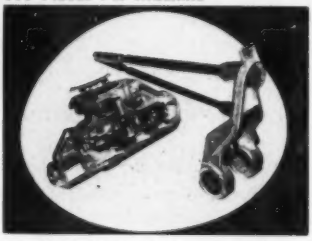
and sintering a mixture of powdered iron and copper. These bearing blocks are produced for the company by Amplex Division of Chrysler Corp., in Super-Oilite.

This small part involves some complex die design and double acting punches to form two different thicknesses. The stepped mounting hole is cored, but requires finish boring, while the two small holes are drilled.

The metal powders chosen for this application are intended for heavy loads involving severe pressure. The pressed and sintered bearings are impregnated with oil to the extent of about 25 percent by volume. Ultimate tensile strength given for this material is 30,000 psi, while permanent deformation on compression occurs at 58,000 psi for .015 inch set.

800 Pieces Per Machine



COMPLEX SHAPE of the creel and cone holder makes it logical to die cast these parts in zinc. Some dimensional relationships are held to close limits.

Two components which are used in large numbers are the creel and cone holder which serve to tension the yarn. As many as 800 of each of these parts may be installed on a single machine and thus, although the individual number of machines produced is not great, the volume of these parts is sufficient to justify the cost of die casting dies.

For this reason, the creel and cone holder, as shown in Figures 4 and 5, are die cast: the creel in zinc alloy and the cone holder in aluminum alloy.

The complex shape of the creel makes this a "natural" for die casting. Integral with the casting are cored holes for mounting two thread guides, adjusting slots for three winding posts are cored and have flanges on the underside to prevent the nut

continued on page 87

STRUCTURAL PARTS by *Powder Metallurgy:*

a report of available metals and their characteristics

By PHILIP R. KALISCHER
Associate Editor

DURING the past 15 years, powder metallurgy has developed from a procedure used almost exclusively for the manufacture of ductile tungsten, molybdenum, and similar materials and for the preparation of sintered carbides, into a recognized method of fabrication for a wide variety of parts. Most of the expository material pertaining to powder metallurgy has dealt with the properties peculiar to the material—that is, such things as oilless bearings, hard magnetic materials, heavy metal, and similar parts or materials which could not be fabricated by any other procedures.

While all of these powder metallurgical parts are unquestionably of importance, and their development has given great impetus to the industry, if powder metallurgy is to compete with more conventional fabricating procedures in the field of structural parts, it behooves the designer to learn something about the possibilities of parts made from metal powders. He needs to be informed what their properties are, what their cost might be, and whether or not powder metallurgy is competitive with other manufacturing processes for structural parts.

Of the many materials which can be made in powder form and then

TABLE I

Some properties of metal powders used for structural parts.

MATERIAL	RANGE OF TENSILE STRENGTH, PSI	HARDNESS RANGE BRINELL	DENSITY RANGE % OF THEORETIC	HARDENABILITY (1)	JOINING (2)	FINISHING (3)	MAGNETIC PROPERTIES (4)	USE
Copper Impregnated Iron	to 60,000	25-100	to theoretical	Poor	S, SS., B	Plating	Poor	Structural parts—particularly high density
Pure Iron (a) Electrolytic iron	to 75,000	25-80	to 90	Poor	W, S, SS., B	All normal for low porosity, parts	Fair	General use—structural & bearings
(b) Swedish sponge	to 50,000	25-90	to 90	Poor	W, S, SS., B	Plating	Poor	General use—structural & bearings
(c) Carbonyl	to 35,000	25-50	to 90	Poor	Not Recommended	Not recommended	Good	Primarily for magnetic materials
Plain Carbon Steel	to 150,000	to 650	to 95	Good	W, S, SS., B	All	Fair (5)	Structural parts
Alloy Steels	to 175,000	to 700	to 95	Good	W, S, BS., B	All	Fair	Structural parts
Stainless Steels Austenitic 18-8	to 65,000	to 135	to 95	———	W	Not needed	———	Replace wrought stainless steel
Bronze 90-10 (6)	to 35,000	to 60	to 90	———	S, SS	Plating	———	Mostly self lubricating bearings Some structural parts
Brass 70-30 (6)	to 35,000	to 40	to 85	———	S, SS	Plating	———	Structural parts, generally replaces cast parts
Pure Copper	to 25,000	to 45	to 95	———	S, SS, B	Plating	———	Seldom used as pure metal —can replace cast copper in some applications.

FOOTNOTES:

(1) Hardenability ratings are based on change in hardness when the material is quenched from a high temperature. It is assumed that some carbon is present to allow hardening to take place if possible. Only that manganese accidentally present is considered, no additional added.

(2) Joining: W - welding, S - soft soldering, SS - silver soldering, B - brazing.

(3) Finishing ratings are for high density (low porosity) parts only. If a part has over 10% porosity, plating, blacking, or other finishing methods requiring immersion in a solution of any kind should not be attempted.

(4) Magnetic properties are for soft magnetic materials only. Permanent magnets fall into a separate class.

(5) Soft magnetic materials only — compare with wrought low carbon steel.

(6) Brass and Bronze of the composition noted are given as typical examples. All other usual compositions can be made whose properties will have the same relationship to their wrought counterparts as the examples given.

processed into parts, those of most interest to the designer are pure iron, copper impregnated iron, plain and alloy steels, stainless steel, brasses and bronzes as distinguished from oilless bearings, pure copper, and perhaps one or two other specialty materials such as high-strength, high-temperature alloys and metallo-ceramic parts. Each of these materials will be discussed separately, and their properties compared with comparable materials made by other fabricating methods.

In addition, the designer should know which powder parts can be assembled into more intricate pieces by welding, soldering, brazing—what types of surface finishes can be secured—the tolerances to be expected, and in some instances, the magnetic characteristics of the powder compacts.

Broadly speaking, parts made from metal powders can compete economically only when the number of pieces to be made is large. Die costs are always high, and unless long runs are made, it is impossible to amortize the die costs and still compete. No hard and fast rule for the number of parts can be given, of course, but generally speaking, if powder metallurgy is to be used as a fabricating method, several thousand pieces must be made.

LIMITS ON SIZE AND TOLERANCE

The size of the piece to be made also enters into consideration. On the low side are parts having a cross section of approx. 1/16th of a square inch, and not less than 1/8" thick. From there, the process can be used up to any size piece for which there is press capacity. Since the normal forming pressure may run as high as 75 tons per square inch, it is probable that parts over 10 to 15 square inches in cross section will represent the upper limit.

The same upper limit for the thickness of the piece is, in general, two to three times the diameter, in the case of a cylindrical piece, or about the same ratio in a piece of other shape, taking the average diameter of a cross section as a measure.

Under some conditions, it is justifiable to hold tolerances on powder metallurgical parts to .001. An example of this is the self-lubricating bearings. In the smaller sizes, up to ½ inch I.D., normal manufacturing tolerances are .001 on the diameter.

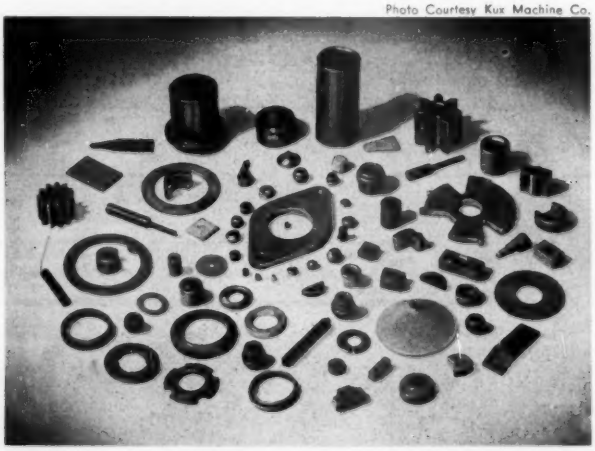
Tolerances on length vary, generally on bearings up to 1½ inches a variation of .010 is allowed. As the sizes increase the tolerances have to be loosened so that on bearings over 2½ inches I.D. the normal manufacturing procedure calls for +.000—.003. Length tolerances are proportionately greater as the size increases.

Structural parts are, as a rule, held to less rigid specifications wherever possible. Unless the part can stand a relatively high manufacturing cost brought on by low die life and a high percentage of rejections the tolerances should not be held any closer than .001 inch per inch. If possible a size specification should not be closer than ± .003

Re-entrant angles cannot be made with any pressing equipment now available, and while it is possible to design a die and press attachments for doing these jobs, the cost is far in excess of the cost of machining the re-entrant portion after the part has been made.

Sharp corners must likewise be avoided, and in all cases the maximum radius allowable should be used. Not only is a reasonable radius necessary from the point of view of preventing stress concentrations in the die and thus cracking the dies, but the parts themselves, as pressed and before sintering, will be extremely weak at all sharp corners. Normal die construction furnishes a highly polished die surface, and utilizing powders of normal size distribution, the finished part will have a smooth surface. Where a super finish is required, lapping or honing after fabrication will be necessary.

Photo Courtesy Kux Machine Co.



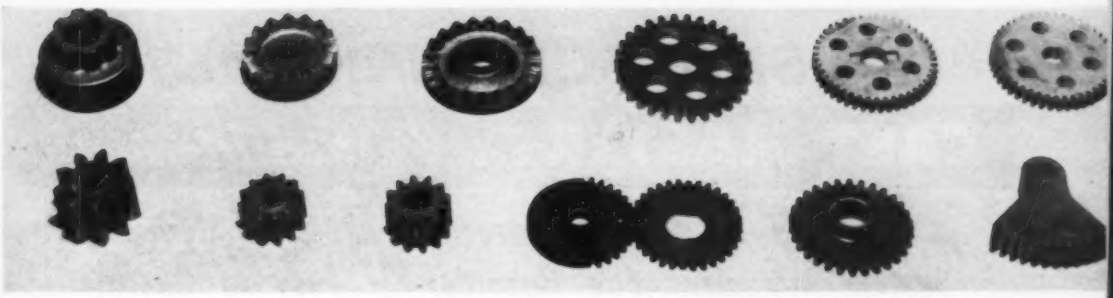


Photo courtesy Plastic Metals Div., National Radiator Co.

Finishing and Joining Powdered Metal Parts

Parts made from metal powders, if of high density (low porosity) can be given most of the normal surface treatments. A powdered iron piece having a density of 90 percent of theoretical density will respond to electroplating, blacking, parkerizing, etc. Occasionally there is some surface porosity on these parts which may cause blistering. In such cases a burnishing operation will close the surface pores. Where this is not possible due to the contour of the part a filler is used. Graphite, for example, has been found to be a satisfactory filler of minor pores prior to electroplating.

These surface finishing operations on powder parts are not as simple as on parts made from bar stock, but with the observation of precautions an adequate finish can be secured.

There will unquestionably arise occasions when the design of a part is such that it cannot be made directly from powder parts. In such cases, it is possible to design the part from a number of smaller parts and assembly carried out by any of the well-known joining methods. Powder parts, particularly iron parts, respond to welding, although a rather special technique is required which will have to be learned by the welder before satisfactory jobs can be done.

All powdered metal parts can be soft soldered if the composition of the material is such that it is solderable. The range of compositions is the same here as it is for wrought materials. This same holds true for silver soldering and for brazing, either torch brazing or furnace brazing. Innumerable parts have been made by assembling components made from metal powder, and then furnace brazing. In some cases, this technique can be made cheaper than in the case of wrought materials, since the sintering and brazing may often be carried out simultaneously.

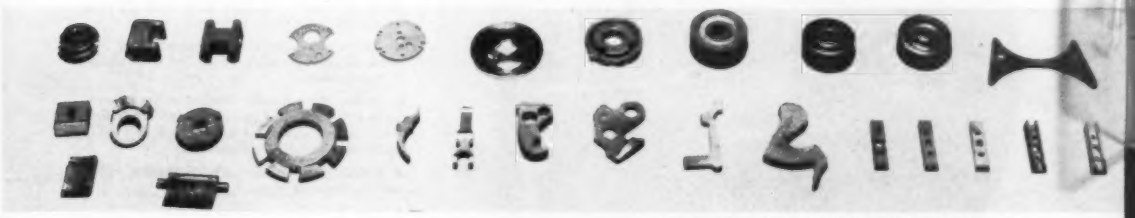


Photo courtesy Plastic Metals Div., National Radiator Co.

Available Metals and Their Characteristics

COPPER IMPREGNATED IRON PARTS

Coming now to the various materials which are available in powdered form, and from which structural parts can be made, one of the most important is pure iron impregnated with copper. Actually, this process is a furnace brazing process, in which the individual particles of iron powder are bonded together with copper, to form a homogeneous part of essentially zero porosity.

Parts made from such an iron-copper mixture exhibit many of the properties of cast metal. Their hardness will range from about 25 to 100 Brinnell. The ultimate tensile strength will run as high as 50 to 60,000 psi, and elongation and reduction in area are generally quite low. These parts are admirably suited for use where they will be subjected to compressive

continued on page 80

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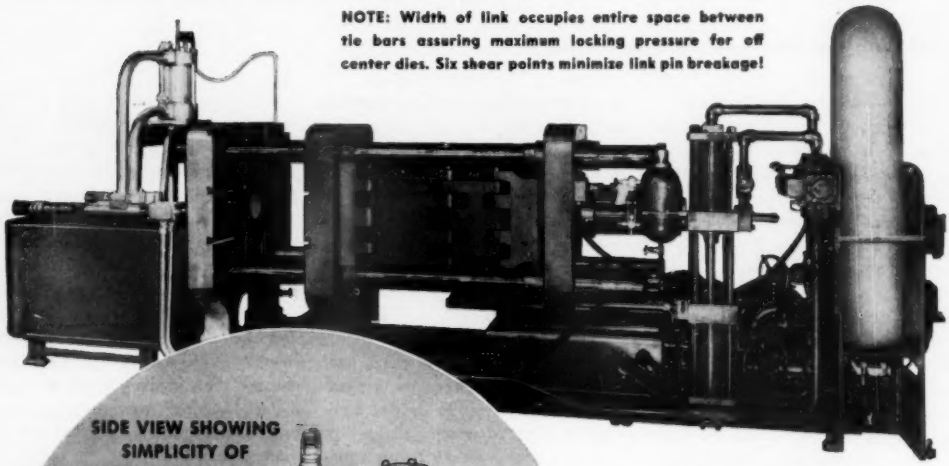

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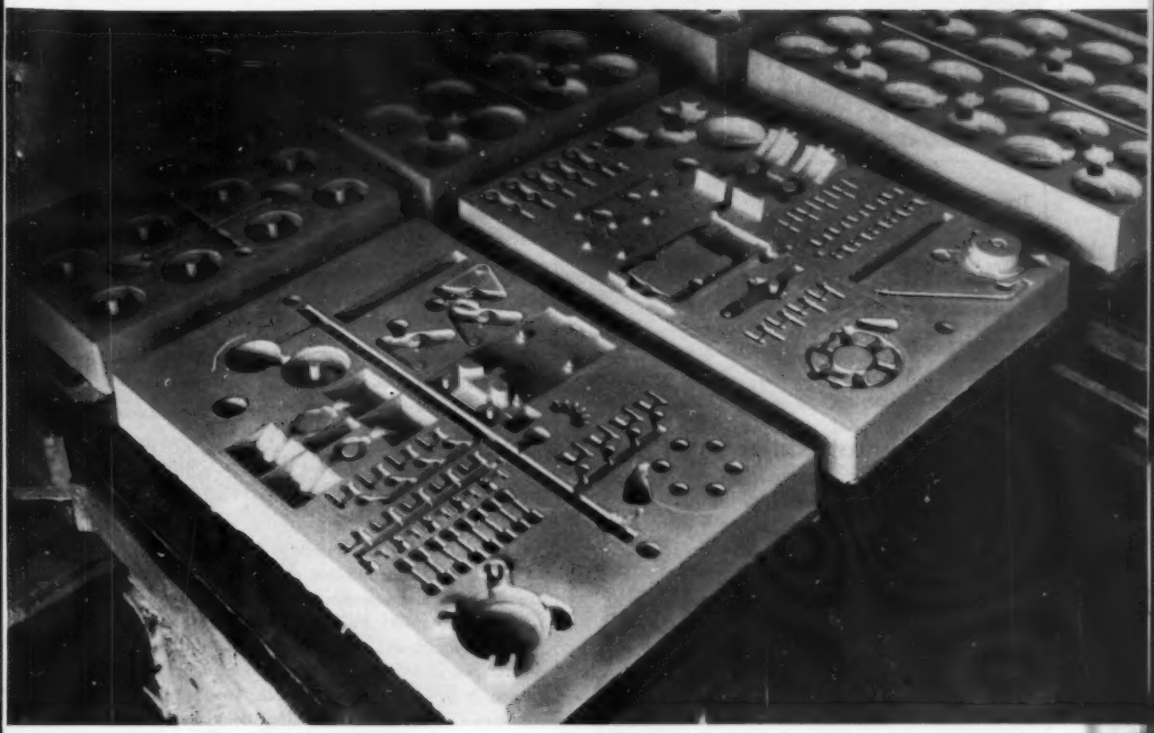

FINISHED PLASTER MOLDS emerging from continuous drying oven. The cope and drag in the foreground illustrate the inter-changeable unit-strip system that results in the economical production of castings even when the quantities are not large enough to justify a full flask of die-patterns.

CASTINGS MADE IN PLASTER MOLDS:

the process, design factors, alloys, tolerances and advantages

By K. A. MIERICKE

THE POURING of molten metal into a gypsum plaster mold offers the designer a combination of dimensional control and surface refinement that has proved to be very useful for a diversified range of products.

This process, while no newcomer to the field of metal casting, has been given new impetus during recent years by the improvement of its techniques so that it has become an effective industrial process for reproducing precision parts on a commercial basis.

The limits, as to accuracy, casting size and rate of production, have all been extended; furthermore, soundness of metal structure has remained one of the prime advantages of the process.

Non-ferrous castings from plaster molds have found important applications in the electronic, automotive, hardware, machinery and allied fields.

Before describing plaster mold casting, a brief discussion of the casting process in general would be helpful. As you doubtless know, casting is probably by far the oldest method of forming metals into a desired ultimate shape. The process goes back well into antiquity, perhaps even beyond the dawn of history. Castings were being made back in the early Chinese period.

Undoubtedly one of the most worthwhile things about casting as a process for forming metals is its simplicity. Reduced to its simplest terms, all that is necessary is a hole of the desired shape and size which is then filled with liquid metal. That is the elementary process. Unfortunately, it isn't quite that simple. The fact that casting has been used for so many centuries has something to do with the fact that the process of casting metals, while the oldest art, is still one of the newest sciences.

The basic advantage of the casting process is that it provides a means of making a replica of a finished

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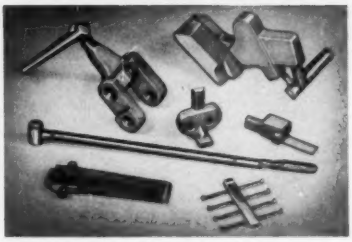
VAN DORNS for
molding styrene patterns

Typical precision parts produced by investment casting, using styrene patterns molded to .003" tolerances on Van Dorn Presses.



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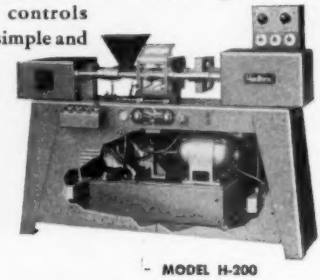

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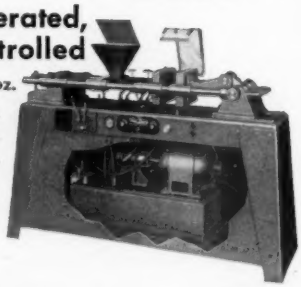
Power-Operated, Lever-Controlled Presses—2-oz. or 1-oz. models. Have many automatic and safety features.



MODEL H-200

Plastic Grinder—grinds up waste, rejects, etc., for re-use.

Mold Bases for these presses available from stock.

Write for information on this equipment.

MODEL G-100

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part in substantially one direct step. However, when we say replica, we are idealizing the situation. Actually, the ordinary sand casting processes do not, with any high degree of accuracy, faithfully reproduce the pattern. A close approach to faithful reproduction has been obtained only by developments of comparatively modern times, namely, the so-called precision casting processes.

When we speak of precision in castings we refer to three kinds of precision, namely:

1. *Precision in dimensions* in the plaster mold process to be described this means approximately ± .005 inches per inch at the best.

2. *Precision in reproduction of surface finish.* This is a matter of obtaining a smooth surface or a substantially polished surface, if necessary.

3. *Precision in reproduction of detail.* Some parts may have very complicated fine detail on the surface, as a series of fine grooves or lines, or fine lettering.

The use of gypsum cement with various additives as a molding compound into which non-ferrous metals are cast is not a new development. For many years ornamental and statuary bronze have been cast in plaster mold compositions. However, during the war years the advantages of metal casting in plaster molds became known, indirectly, to many people. This led to ideas, sometimes exaggerated, as to what could be and what could not be produced by this process. Precision metal casting is a comparatively undeveloped industrial art, but it has reached the stage where it is reducing overall costs and improving the quality of the castings.

In many instances, metal casting in plaster molds can be substituted for other casting methods in order to eliminate a long series of expensive machining operations of a given part.

Loss, due to rejections, can be greatly reduced because rejected parts involve the loss of only the plaster molding and metal casting operations. In ordinary sand castings, porosity, or other common sand casting defects are often only discovered after a series of machining operations and the loss incurred due to rejection at this point involves not only the cost of the molding and casting operations but also the cost accumulated in the machining operations.

It was because of the rather wide-spread interest in the use of gypsum plaster for metal casting and because of the need for certain features not possible by other processes that an intensive research program was undertaken to produce an improved metal casting plaster, which would be adapted to the casting of nonferrous metals and alloys.

MATERIAL

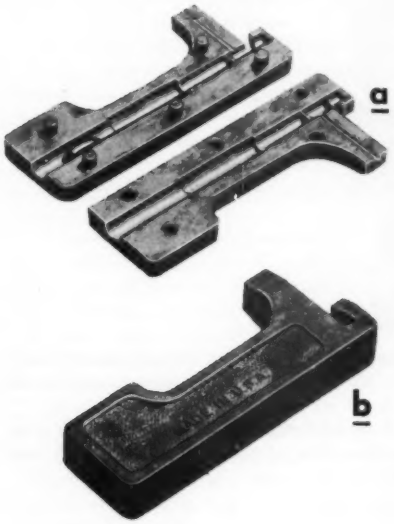
The plaster is usually compounded with various types of fibrous and refractory aggregates such as fi-

continued on page 55

DO's and DON'Ts in DESIGNING ZINC and ALUMINUM DIE CASTINGS

examples by DOLLIN

PRINCIPLE: **For lowest final cost when two or more die castings are to be fastened together, first consider incorporating holes and mating pins as the means of assembly.**



EXAMPLE: The manufacturer's original design for this needle threader part called for fastening halves a together by means of a screw. Dollin engineers suggested the hole and mating pin arrangement shown. With tolerances for a light press fit, these halves are quickly and easily assembled b with one stroke of a punch press. Thus the extra costs of buying screws, tapping holes, and screwing the halves together, were avoided.

RESULT: Substantially lower costs for the manufacturer.

● Needle threader parts die cast in Dollin's Small Castings Department. Here high speed automatic casting machines with small single or double cavity dies permit widest design range, provide high production with low die and casting costs.

● Dollin engineers will work with you on design refinements—recommend whatever changes will reduce overall cost. Our facilities are broad, modern—make possible low cost production of die castings of all commercial sizes. We have long been serving many of the country's leading manufacturers.
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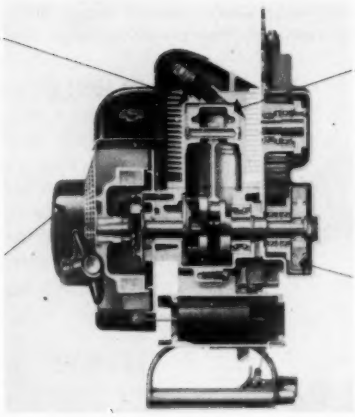
LIGHT AND STRONG CONSTRUCTION

Permanent Mold Casting and



How to build a portable power saw that is light enough to work with and rugged enough to take the punishment is illustrated by the section view.
Choice of the right material and fabricating method for each component depends upon a combination of functional suitability and manufacturing economy.

GONE ARE THE DAYS when small-to-medium sized structural, functional or housing parts of a mechanism need to be hogged out of the solid or machined all over from rough sand castings.

Newer fabricating techniques growing out of recent advances in metal working technology, together with availability of improved alloys, compositions and metallurgical structures, enable the product designer to "hit the nail on the head"—to achieve major design objectives with the fewest possible secondary operations and processing.

- The designer can now specify many critical dimensions at, or close to, finish size.

- He can call for and get an impressive range of properties and physical characteristics.

- He can readily obtain complex shapes which once would have given the production engineer gray hair.

- And he can impart functional improvements to his product by means of these processes.

The Homelite Corporation has utilized several of these precision fabricating methods to good advantage in its new, portable, gasoline powered, chain saw. The selection of production methods for several components of this chain saw should prove interesting.

Many of the sales features of this saw can be traced directly to the choice of materials and fabricating methods. These include its dependable starting, automatic clutch, light weight and cool operation.

obtained with *Die Casting, Investment Casting, Powder Metallurgy*

To take the high stress of the full starting load, the starter assembly has been built around a pair of beryllium copper investment castings.

In this unit, built on the principle of an over-running clutch, a control ratchet engages at least one of three hardened steel balls, locking the ratchet to the outer ring for the purpose of cranking. As the engine gathers speed, the trailing edge of the ratchet teeth forces the balls into their respective pockets in the outer ring, where they are held by centrifugal force until the engine is stopped.

To accommodate this load, an alloy that is both tough and hard, and can readily be cast, has been chosen. This material, beryllium copper, is an age hardening alloy with high abrasion resistance and tensile strength. Beryllium copper has good fluidity in its molten state and is castible in thin sections, thus being suitable for investment casting.

These two parts were previously sand cast in bronze but when the need for a tougher alloy was indicated, the company turned to investment cast beryllium copper. Here, parts have been produced with much thinner cross section but, at the same, with greater mechanical strength.

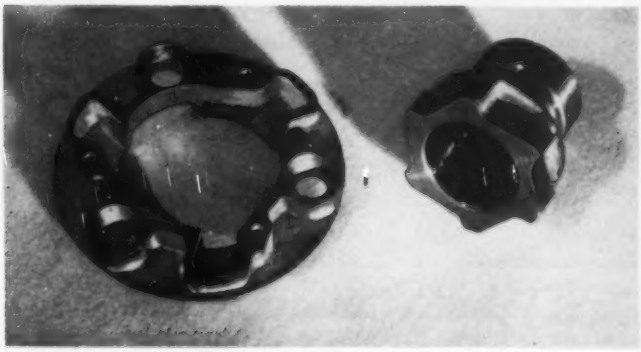
The investment cast parts are produced for Homelite by the Z & H Manufacturing Company of Peekskill, N.Y. The outer ring, with its three irregularly shaped pockets and three countersunk mounting holes, is cast to finished dimensions. The only machining on this unit is the tapping of three small holes.

Because investment casting permits thin, accurately-controlled wall sections, it has been possible to reduce the weight of the starter mechanism. The excess reinforcing thickness of metal previously required is no longer necessary.

The ratchet required boring of the ID and turning the OD of the shaft. Close outside fit and close requirements on concentricity make it preferable to finish machine these surfaces, although the amount of stock left for finishing is very small. It is also necessary to face the bottom of the ratchet and to turn a groove around the shaft. The complex shape of the ratchet, however, is cast to size and needs no work.

BERYLLIUM COPPER INVESTMENT CASTINGS WITHSTAND STARTING LOAD

Ratchet and outer ring of starter are investment castings.



CLUTCH SHOES with irregular contours by *Powder*

Positive metal-to-metal grip is provided in the automatic clutch by means of six powdered metal clutch shoes having complex contour and several critical dimensions.

A machined aluminum hub with radial slots serves to mount the six clutch shoes, as shown in Figure 4. Coil springs set into machined grooves on the top and bottom surfaces of the shoes serve as retainers.

The width of the shank of the powdered metal parts is critical. The shank rides in the machined radial slot in the hub, and any looseness in fit would result in sideplay causing uneven wear or malfunction of the clutch segment.

Due to the difficult contour and closeness of tolerance, it is necessary to size these parts in a die after sintering. The groove for the coil spring is undercut and therefore cannot be pressed in, although a V-shaped groove is pressed in and the undercut is subsequently milled.

Amplex Division of Chrysler Corporation presses these pieces in bronze powder for Homelite. The required friction characteristics are thus obtained.

One advantage of this type of clutch shoe over those produced by cementing a friction material onto a backing is the permanent life of the powdered metal unit. As the surface wears, the piece still maintains its effective shape and friction properties.

WELDED GAS-OIL TANK IS REPLACED BY DIE CASTINGS

Both magnesium and aluminum die castings have been used for such housing components as cylinder gasoline-and-oil tank, covers, transmission housing and similar parts. The average weight saving for these parts is one-third over the previous fabrication, and in a piece of portable equipment requiring constant physical exertion of the operator, every saving in weight is an improvement in functional efficiency.

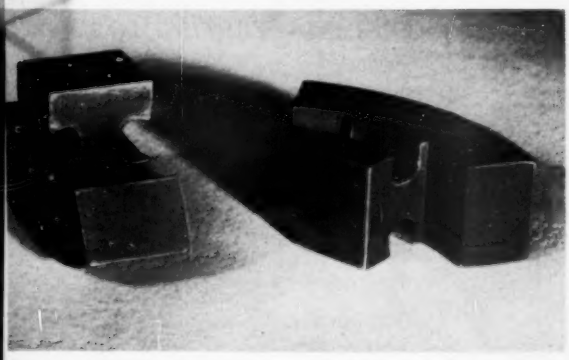
The gas tank of the saw had been fabricated in previous models by welding steel sheet, cut and formed to an irregular shape. Since the saw has been designed for compactness, with the gas tank "wrapped around" part of the motor, the unusual shape of the tank was a real welding problem.

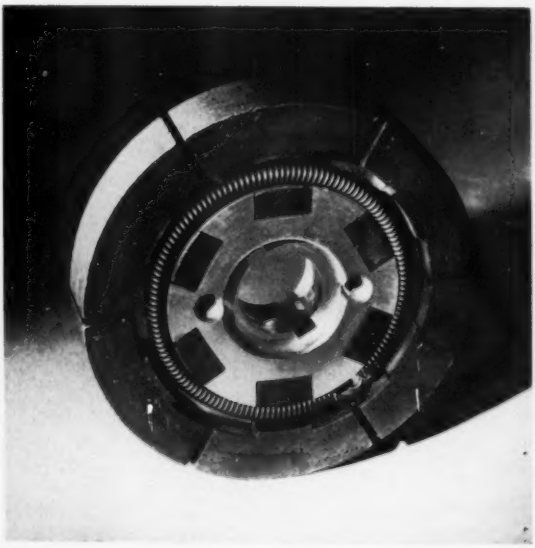
On the production line, the tank required welding around the edge, plus spot welding and soldering of the partition between gas and oil compartments. This furthermore, offered a difficult problem in sealing and testing.

Naturally, with a one-piece die cast construction, the

Width of the shank of these clutch shoes is critical because it rides in a machined slot, as shown at **right** and is sized after sintering.

Critical shank dimensions and difficult contour on these clutch shoes.





partition is built in, and the only sealing required is around the top and openings. Even here, the accuracy of mating die cast parts has simplified the sealing problem.

Average wall thickness on the gas tank is about 3/32 inch as die cast, while certain other housing die castings are somewhat thinner and compare favorably with sheet metal; yet the ability to form integral ribs, reinforcements and thickened sections where needed, plus the inherent high strength-to-weight ratio of the cast aluminum and magnesium alloys — has produced strong impact resistance and tensile strength.

Secondary operations on the gas tank consist of a light sanding of the top edges to remove flash, tapping of holes before sealing, and screw assembly.

The thin, uniform walls of the aluminum cylinder, with fins to help in rapid dissipation of heat, contributes to coolness of operation. The cylinder is die cast in aluminum and despite its complex shape, it requires only finish boring of the cylinder to remove draft, and facing of the mounting surface, along with drilling the angular hole for mounting the spark plug.

All die cast parts are produced for Homelite by Aluminum Company of America. Magnesium die castings are chromated to prevent corrosion in salt atmosphere.

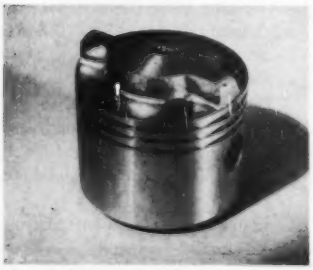
The housing which rests on top of the cylinder is another die cast magnesium piece which would be extremely difficult to draw from sheet heavy enough to withstand the stress. Two feet on the inside of the housing are formed as integral parts of the die casting, and rest upon the top of the cylinder for added reinforcement.

The piston is produced by permanent mold casting because of its favorable metallurgical structure due to the slower chilling of the piece. The permanent mold aluminum piston is cast in Stellite molds by Bohn Aluminum Company.

Aluminum die cast cylinder with chrome plated lining

Thin-walled, rigid housings die cast as thin as sheet meta

Combination gas-oil tank eliminates difficult welding.



Complex, thin-wall components by *Die Casting*

Piston by *Permanent Mold Casting*

Here's how Twin City Castings CUT ASSEMBLY COSTS on Brown and Bigelow's Rediflame Gas Lighter

You get *more* than castings that meet specifications from Twin City. Over 30 years' experience has given Twin City Die Casting Co. the die-making ingenuity and casting know-how that not only holds castings to tolerances . . . but *cuts production costs* and *HELPS MAKE SALES!* Here's how Twin City applied that experience to casting parts for Brown & Bigelow's popular Rediflame gas lighter.

THIS WAS THE JOB:

Cast a light-weight desk model lighter body holding all tolerances. Every casting to be smooth and accurate to accommodate seals and "O" rings. Body to be built around two large *opposing* cores. Eliminate shrink drop. Cast top and lever to specifications, lever to be plated.

THIS WAS TWIN CITY'S ANSWER:

All specifications were met and held. Rediflame body was cast in aluminum, lever and top in zinc. By working with the customer's engineers, additional cores were included in the die to eliminate assembly operations. In other places, drill spots were cast. "O" rings sealed perfectly as required.

HERE'S WHAT THIS CAN MEAN TO YOU!

Twin City's ability to work with your engineers to cut your final production costs . . . its years of experience and casting know-how can show real *profits* for you. Get all the facts, contact Twin City Die Casting Co., oldest die-casters in the upper Midwest. Let Twin City engineers demonstrate how experience can pay off for you.

TWIN CITY DIE CASTINGS CO.

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continued from page 50

brous talc and finely ground silica, pumice stone, clay, graphite, etc.

A composition widely used for the preparation of such molds comprises 70-80 percent plaster of Paris and 30-20 percent fibrous talc.

In use, compositions of this type are generally mixed with a relatively high proportion of water, in the range of 120-180 parts of water to 100 parts of plaster by weight. The plaster slurry or mix so formed is poured over a pattern and allowed to set. The set mold is dehydrated completely to liberate the free and chemically combined water.

Dehydration is necessary to insure complete removal of all free and chemically combined water, since the presence of even minute amounts of water in the mold at the time of casting would result in the production of imperfect castings. The heat of the molten metal would convert any water present into steam, which cannot escape very readily because of the low permeability of this type of mold, and would result in rough surfaces and blow-holes in the casting.

The high temperatures employed in the dehydration, or burnout process are accompanied by mold shrinkages ranging from 1.0 to 2.0 percent, depending on the temperature used. The higher the burnout temperature, the higher the degree of mold shrinkage. In addition, the strength of the mold as cast which is about 100 psi, is reduced by half in the burnout.

ADVANTAGES OVER SAND CASTING

The advantages accrued from the use of plaster composition molds over sand foundry practice are as follows:

1. *Accurate Reproduction of Fine Pattern Surface Details*
   Plaster molds are superior to sand molds in producing smooth and finely detailed surfaces.
2. *Production of Dimensionally Accurate Castings*
   Savings in machine finishing operations are frequently more than

sufficient to compensate for the increased cost of mold materials and processing of plaster molds as compared to sand molds.

3. *Large Scale Production of Small Detailed Castings*
   This results in efficient production line operation using mutiple cavity molds.
4. *Better Metal Characteristics*
   Due to the slower cooling of cast metal in highly refractory plaster composition molds, better brass and bronze characteristics are obtained.
5. *Directional Solidification Can Be Controlled*
   Smaller gating systems and lower pouring temperatures can be used because of the high refractory value of the molds.

PROCESSES

Among special processes used to make plaster mold castings are the Capaco process*, an automatic and highly mechanized system that allows close scheduling of production; the Antioch process*, which utilizes steam treatment of the molds to attain high permeability and consequent denseness of castings; and the pressure cast match plate process, which utilizes pressure injection of the molten metal to offset the effect of low permeability in the mold.

*Reg. U. S. Patent Off.

TOLERANCES

In general, a tolerance of plus or minus 0.005 inch per inch of dimension can be held. Where the dimension crosses the parting line the tolerance is increased to plus or minus 0.010 inch per inch. In specific portions of a casting, however, more exacting tolerances are practical.

Cored dimensions within a casting can also be held to plus or minus 0.005 inch per inch. Center-to-center dimensions of holes produced by separate cores can be held to the same limits. Tolerances on integral-core portions must take into consideration the draft angle which is required.

Flatness of surface which can be obtained depends to some extent upon the casting design. As a rule, areas of roughly one square inch are readily held flat within 0.005 inch. Larger surfaces, say approximately six square inches, may sustain a warpage ranging from 0.007 to 0.015 inch.

Surface roughness in production can be consistently held to 30 microinches, rms, or better. The velvet-smooth surfaces produced are well suited for any parts to be plated.

DESIGN CONSIDERATIONS

Most important feature of the plaster-mold casting process is the practicability of producing parts to exacting dimensions so that machining, finishing, balancing, etc., are almost totally eliminated. Parts having internal splines, ratchet teeth, stops, blind gear teeth, airfoil-section blades, integral rivets, etc., which are ordinarily difficult and expensive to machine, can be readily produced. Gears may be cast to regular machining accuracy.

As with most casting methods, draft is required but with plaster-mold casting it is needed in order to facilitate withdrawal of the plaster mold from the patterns. Outside surfaces usually require a ½ degree draft angle and inside surfaces, ½ to 3

Al Mg Zn Fe Cu Si

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degrees. Holes or cavities formed by loose cores require no draft but integral core sections do.

CORES

Several pieces can be consolidated into one part by means of separate core pieces but never by loose pieces on the pattern. Undercuts and intricate passages are readily produced. Holes under ½ inch diameter normally can be drilled more economically than cored. Drill spots, however, can be placed on the pattern to eliminate fixtures.

WALL THICKNESS

Plaster, being a poor conductor of heat, is ideal for producing thin, sound walls. Where the area does not exceed 2 square inches a wall of 0.040 inch can be cast. For larger areas the practical minimum wall thickness increases, for 4 to 6 square inches a thickness of 0.062 inch being minimum and for areas up to 30 square inches the minimum is generally set at 0.093 inch. Tapering sections are readily producible and blade sections can be cast with knife sharp edges.

STOCK ALLOWANCES

Round, square or odd-shape holes may be cast with only a minimum of stock machining. Ordinarily where machining is required for any reason, 1/32 inch metal allowance is sufficient but less can be allowed on small parts and cored holes, especially where broaching is to be used.

MARKINGS AND INSERTS

Markings of almost any nature can be clearly reproduced. Lettering may be either raised or depressed as desired. Additional features such as steel or other inserts may be cast-in with the usual considerations for galvanic action and sufficient strength to resist cracking of the casting on cooling.

TYPICAL APPLICATIONS

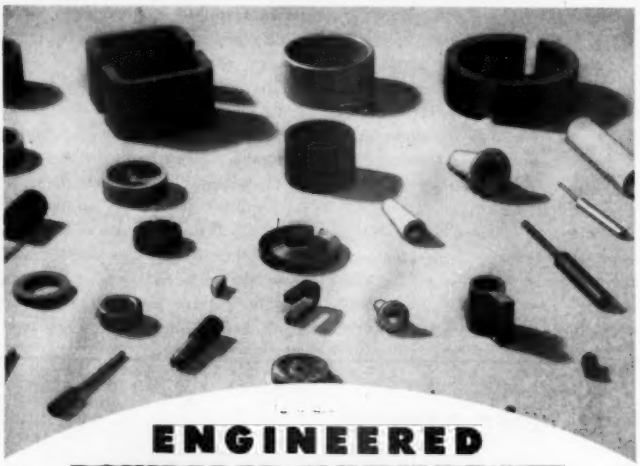
Industry has found many applications for plaster mold castings. Their uniform homogeneous grain structure has made them highly acceptable for use in *electronic equipment* for which purpose the slightest porosity or imperfection would preclude the use of castings. Such items as cable clamps, pole line leadware, wire connectors, brush holders and contactors can be cast in plaster mold from high conductivity copper. Other electrical components can be cast from silican bronze, manganese bronze, aluminum bronze or yellow brass alloys.

IMPELLERS

An outstanding feature of the plaster mold process is the casting of impellers both in aluminum and in copper base alloys. By means of intricate cores, laborious and costly machining and hand filing operations can be eliminated.

Shrouded impellers are cast in one piece. The efficiency of any impeller depends upon the conditon of the inside surface. Impellers cast in plaster have a higher efficiency, because cored interior surfaces have the same satin-smooth finish as external surfaces. Here too a wide variety of castable

continued on page 87



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12,000 PSI YIELD STRENGTH REQUIRED of *Permanent Mold Casting*

By WAYNE MARTIN*

SINCE the end of World War II, an interesting application for permanent mold castings in aluminum and magnesium has been developed in the automotive industry.

Convertible top rails and brackets have for years been made of malleable iron castings and steel fabrication. More recently, new designs have made use of permanent mold light metal castings.

By January 1, 1951, more than half of all convertibles made in this country were built with tops containing some aluminum permanent mold castings. With NPA restrictions on aluminum for use in the auto industry, several of these parts were converted to magnesium by Keystar Castings Corp. of Cleveland.

Molds which had produced parts in aluminum were modified slightly and satisfactory castings were poured in these molds in magnesium. The mold equipment is now such that castings may be poured in either aluminum or magnesium as conditions of economy or availability would indicate.

This represents one of the first sizeable applications of light metals to the auto industry since the advent of aluminum pistons. It suggests the possibility of other structural uses for these metals.

Tops made of light metal castings are considerably lighter due both to the lower specific gravity of the metal and the thinner, more accurate sections which are possible.

As there are fewer parts in the tops made of light metal permanent mold castings, they can be produced at considerably lower cost than the older designs based on malleable iron.

In structural parts of this type, strength of materials is one of the critical considerations. Auto builders who use permanent mold frames insist that they meet a test which simulates the operation of the top mechanism inside of a garage. The frame must be strong enough to stall the motor without breaking when the

continued on page 90

SIDE FRAMES for convertible tops must withstand rigorous strength tests. These magnesium permanent mold castings are typical of those being used for at least 50 percent of current production.

TABLE 1

	Dowmetal C-HTA*	Aluminum 355T6*
Tensile strength, psi	40,000	40,000
Yield strength, psi	22,000	27,000
Elongation, % in 2"	5.0	3.0

*Solution heat treated and precipitation hardened.

MOLDS THAT CAN BE CAST in either aluminum or magnesium permit flexibility of design. Current market conditions and availability will dictate choice of alloy.

*Vice President, Keystar Castings Corp.

SMALL GEAR HOUSINGS: when is it practical to produce a transmission case by *Investment Casting*

By L. W. MILLIN*

Ordinarily, such parts might be considered for production only by die casting, permanent mold casting or sand casting, depending upon the quantities involved and the degree of finish and surface detail required.

Under certain circumstances, it becomes preferable to plan such gear housings for production as investment castings. On small gear boxes that require smooth, clean finish and where machining must be kept to an absolute minimum, either investment casting or die casting will provide the answer.

HIGH TENSILE strength is obtained in this gear box for the Sattley Manufacturing Co. of Detroit by investment casting it in an aluminum bronze alloy.

When, in addition to the above, there is a need for an alloy with high melting point, or there are specific corrosion conditions to be met requiring a special alloy, then an investment casting provides the better solution. Also, where production runs may be too limited to justify the high initial tool cost for die casting, the introduction of an investment casting with low initial cost is indicated.

In the case of small gear boxes manufactured by Cadmet Corp., an aluminum bronze similar to No. 18 or 20 Ampco bronze is employed because of the need for high tensile strength and corrosion resistance. This alloy is also cast in an investment mold quite readily.

For the designer interested in the possibility of utilizing this high-accuracy process for small gear boxes, whether in extremely small quantities or in lengthy production runs, some general information is submitted here for guidance in determining tolerances, draft allowances and other data.

In most instances, tolerances can be held to ±.005 per lineal inch. This might vary in some instances, especially on cross sections where it is difficult to determine just how much a part will shrink. This is true where a part has two or more cores which would tend to lock the pattern and reduce the shrinkage therein. It also holds true for the alignment on bearing holes where no attempt is made to core finished dimensions, but instead, in some instances, the holes are cored leaving boring stock.

Any draft allowance, especially on a deep draw, is always favorable. In parts such as gear boxes, where there is a full-depth cavity, it is desirable to have at least a one degree draft on the side. There are many instances where even as great as a five degree draft is allowable.

In investment casting, as is also true in sand casting and die casting, it is always advisable to sprue into the heaviest boss on the part. This allows the continuation of metal feeding so that the last section (the heaviest part) is fed until such time as it is solidified, thereby eliminating porosity.

There are certain conditions arising on parts containing more than one boss whereby it is desirable to sprue into one boss and core the holes in the remaining bosses to eliminate porosity in the latter. By this coring

continued on page 87

*The Cadmet Corp., Detroit, Mich.

FINISHING SECTION

MACHINING—Most precision metal molded parts require some machining operations. In this section will be found information to aid in planning and selecting the proper methods and equipment for these operations.

ASSEMBLING—Precision metal molded parts are generally components of assemblies. This section includes information on fastenings and methods for mass production assembly operations.

SURFACE FINISHING—Many precision metal molded parts receive some type of surface finish such as plating, organic coating, anodic coating or chemical coating. This section includes information on the methods, processes and equipment used for these surface treatments.

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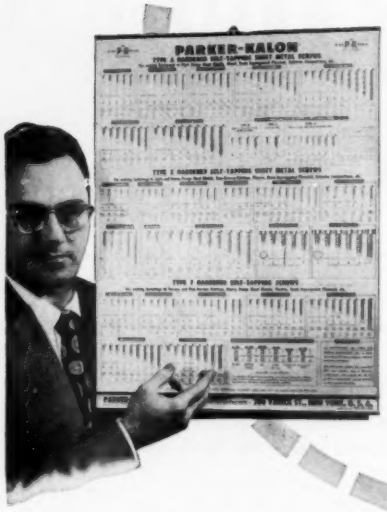

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PRODUCTION CLINIC

PLATING ZINC BASE DIE CASTINGS:

a report on the A.E.S. sessions

IN one of the major technical sessions of its annual convention, the American Electroplaters' Society turned its attention to the subject of the preparation of zinc base die castings for electroplating. Abstracts of these papers are printed below.

Meeting in a four-day session at Buffalo, N. Y., July 28-August 2, the A.E.S. the convention had a record registration of 1358.

New York City has been chosen as the site for the A.E.S. convention in 1954. Previously, Chicago had been determined as the location for the 1952 sessions, and Philadelphia for 1953.

Dr. A. Gardner Foulke of the Hanson-Van Winkle-Munning Company has been appointed to succeed Dr. A. Kenneth Graham when he retires from the post of executive secretary of the Society this year.

In addition to the technical session devoted to plating of die castings, other sessions included "Engineering Aspects of Electroplating", "Substitute Finishes for Electroplating", "Some Practical Aspects of plating Room Control" and a "Report on A.E.S. Research Program".

Chairman of the meeting on surface preparation of zinc die castings was Dr. R. B. Saltonstall. Abstracts of these papers are printed below.

MECHANICAL FINISHING OF ZINC BASE DIE CASTINGS PRIOR TO PLATING

M. R. Caldwell
Assistant Vice-President
Doehler-Jarvis Corp.
Grand Rapids, Mich.

A properly designed die with a well polished and chromium plated cavity should produce die castings with a surface that would need no buffing prior to plating. However, even in the absence of surface defects as the casting is removed from the die, the parting lines must be trimmed off and polished, and these operations generally cause nicks and scratches that necessitate buffing of the entire bright area.

The dense "skin" on the casting should be preserved during buffing in order that the number of corrosion spots be kept at a minimum. Only very shallow pores in the surface can be bridged during copper-nickel plating; others can be removed by polishing or hard buffing for maximum corrosion resistance. However, air pockets in shallow pores will expand during baking of the plated castings and raise blisters.

Dr. R. B. Saltonstall

Machine finishing is a necessity to reduce cost and meet production requirements in the author's plant with its large production—in 1950, 280,000 castings daily, weighing 0.43 lb on the average and 15.5 lb maximum.

Size and contour, required final finish, presence of holes and threads, possibility of distortion, and adaptability to automatic machine polishing are factors which are taken into account in the choice of finishing method.

Many small parts are barrel burnished, sometimes after a strapping (belt polishing) of the parting line, in 2-compartment, 32 inch diameter, 60-inch long barrels, run at 30 rpm at first and then 6-10 rpm for final coloring.

Parting lines are usually strapped, by hand or automatically, before buffing. Abrasive belts are preferred to set-up wheels because of the elimination of skilled labor and savings in material and labor. Polished areas and coarseness of polishing grain are continually kept at the minimum required by the condition of the part, and use of grease stick at a maximum, to reduce cost of subsequent buffing. Type of buff and buff speed are carefully selected for the same reason.

Liquid tripoli buffing compounds are rapidly gaining favor, even in hand buffing, and are carefully selected for minimum consumption, buff wear, and ease of removal by cleaning. Applications can be made

automatic. The recirculating, pump-type system is preferred over the pressure-can system because it eliminates transfer of compound and keeps it uniform.

A wide variety of automatic buffing machines are used: semiautomatic, reversing type with only one fixture (two to a part), straight-line and return-type full automatic with fixture guides and tilting mechanisms.

Areas not reached on the machine are touched up by hand, sometimes with a portable high-speed head when the fixture is turning an end of a return-type automatic.

Optimum wheel pressure, once set, is controlled by an ammeter on the motor, which automatically considers the wheel speed.

REQUIREMENTS OF ZINC BASE DIE CASTINGS FOR ELECTROPLATING

Glenwood J. Beckwith
Vice-president and General Manager
Metallon Products, Inc.
Los Angeles 1, Calif.

Zinc base die castings which are suitable for electroplating can be produced only when due care is exercised with regard to the design of the article, the design of the dies, the casting technique in the foundry, and the composition of the zinc alloy.

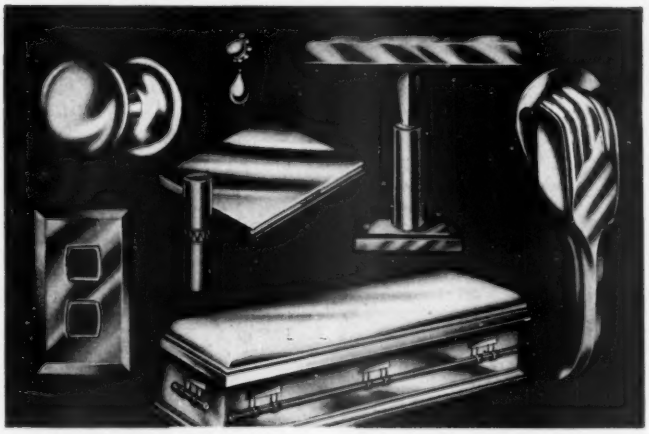
The design of the article should be such that polishing can be easily accomplished without expensive special equipment or excessive hand labor. In addition to ease of polishing, the designer should keep in mind the requirements of the plater with respect to ease of racking for good contact, proper drainage and satisfactory throwing of metal to all parts of the article.

A die which is not properly designed will be the source of castings which contain coarse-grained areas, cold shuts, rough surfaces, and other defects which cause the plater a great deal of trouble and may lead to a ruinous number of rejects. Even trimming dies which are not properly aligned or are otherwise faulty will produce castings which are hard to polish, and the excessive polishing may very well cause plating troubles.

Foundry technique which does not recognize the effects metal and die temperatures, lubricants, poor skimming, and the use of excessive amounts of scrap in the pot will inevitably lead to poor castings which will be difficult to plate properly.

Even the type of furnace is important. A gas-fired furnace, for example, may be the cause of porous castings if the metal is exposed to the products of combustion. Probably no single factor is so important as proper foundry technique in the production of good castings.

Some of the impurities which may find their way into die casting alloys can be the source of important plating troubles. Lead and cadmium are particularly troublesome, and even small amounts will cause blistering after plating. Many other impurities such as tin promote subsurface corrosion, and cause effects which may be blamed upon the plater.



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ELECTROPLATING ZINC BASE DIE CASTINGS

Chester G. Borlet,
District Manager
United Chromium, Inc.

One or more of a large number of metals may be deposited on a zinc base die casting, but all coatings must conform generally to specifications which cover general appearance, arrangement of multiple deposits, minimum thicknesses, resistance to salt-spray, ductility and adhesion.

In all of the plating processes employed in meeting the specifications careful control must be exercised over the variables which are responsible for the success of the plating operation. The variables can be divided into two categories, namely, internal variables comprising composition, pH, temperature, current density and impurities; and the external variables which include rinsing, agitation, current source, plating racks and filtration.

Even though all components of a plating solution may be present in the correct relative amounts, excessive or insufficient total concentrations may result in poor deposits. Some baths are particularly sensitive to pH, and must be controlled very carefully. Current density and temperature are closely inter-related, and the selection of operating ranges for each of these variables requires a careful consideration of many factors, among which the geometry of the work and the current distribution on it are of utmost importance.

Impurities are a fruitful source of plating difficulties, but techniques for their removal have been well established.

Sufficient rinsing facilities should be provided to remove all chemicals from the work before it goes to the next operation. The necessity of continually replenishing the solution around the cathodes requires agitation which may be accomplished in a number of ways, either mechanically or pneumatically.

Whatever the current source, it should be designed for the work in hand and operated under the conditions of load for which it was designed.

Well-engineered racks properly coated with an insulator which will not contaminate the solution are required for the production of good deposits.

Proper filtration helps immensely in the avoidance of rough deposits.

CHEMICAL AND ELECTROCHEMICAL PREPARATION OF ZINC BASE DIE CASTINGS FOR ELECTROPLATING

Earl W. Arnold
Technical Service Engineer
L. H. Butcher Company
Los Angeles, Calif.

The preparation of zinc base die castings for plating consists of a precleaning operation, electrolytic cleaning and an acid dip or etching operation.

The precleaning, whose function is to remove contamination to a point where the electrolytic cleaner is effective, can be accomplished by organic-solvent cleaning, emulsion soak and spray, or alkaline soak. Organic solvents can be used in the vapor, spray

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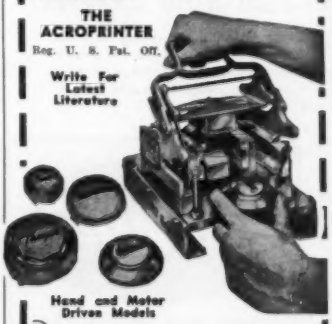
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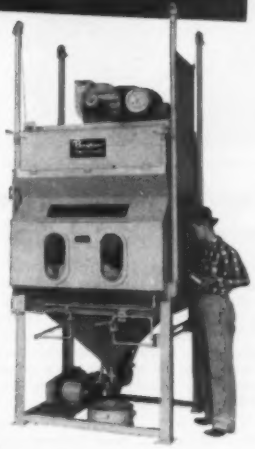
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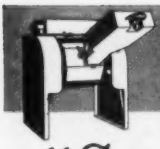

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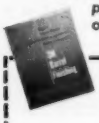

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or immersion techniques or combinations thereof depending on the size and shape of the parts being cleaned or the nature of the soil.

Emulsion cleaners are particularly useful for zinc base die castings in that they are effective, economical and do not attack the base metal even on long exposure. They lend themselves to use in a wide variety of ways including power washing machines.

Precleaning with alkaline-soak cleaners should be limited to those cases where contamination is slight, but such cleaners have the advantages of low initial cost and maintenance.

Electrolytic cleaning may be either anodic, cathodic or a combination of both, but with any of the techniques care must be exercised to see that the surface of the die casting remains virtually unchanged after going through the electrolytic cleaning cycle.

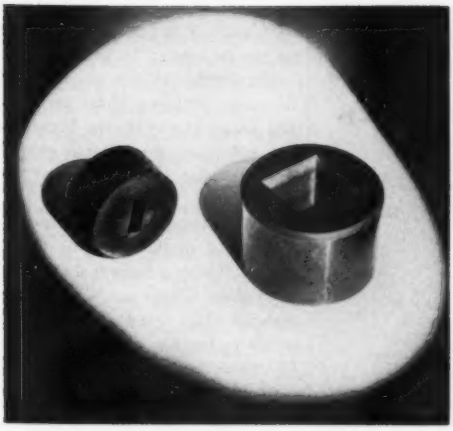
Although the composition of the cleaner is important, the success of the operation depends largely on such factors as temperature, concentration, cleaning time and current density. It is important to replace the cleaner frequently or trouble from blistering or poor adhesion will be encountered.

Perfect adhesion of the deposit to zinc base die castings can be obtained only when all harmful films are removed from the casting. The proper acid dip will eliminate surface oxides and chemical films from previous operations. Sulfuric, hydrochloric, hydrofluoric, or fluoboric acids may all be employed satisfactorily when used under the proper conditions, and phosphoric and acetic acids have found some favor.

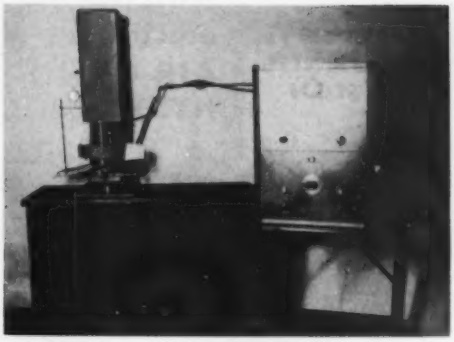
The time of immersion is determined by the first signs of gas evolution. Rinsing after acid dipping should be thorough to prevent contamination of solutions in subsequent operations.

HEADS MILWAUKEE SALES

H. C. Ende, Jr. has been appointed Milwaukee district sales manager for Crucible Steel Company of America, it has been announced by W. H. Wiewel of Pittsburgh, Crucible vice president in charge of sales.



Die blanks cut in carbide



The cavitron machine

Machining Method for Carbides

Fine surface detail, screw thread cut in carbide

A MEANS of cutting holes of regular or irregular contour in hard materials such as cemented carbide has been introduced and appears to have a number of vital applications for such jobs as producing certain types of die cavities, reproducing fine detail on a die surface, cutting mounting holes or screw threads in carbide tools or cutting into hard materials such as gems, glass, hardened tool steel and similar materials.

The process, which involves a low-cost tool, a relatively simple machine setup and which may be handled by inexperienced labor, is called the Cavitron process, and has been developed by the Cavitron Equipment Corporation of New York City.

It was developed originally as a means of cutting detailed settings for small emblems in precious stone, but its inventors soon realized that the machine offered great possibilities for industrial use, and set about adapting it for this purpose.

Dies suitable for powder metallurgy, drawing, and other related applications are considered entirely feasible by this method. It also suggests possibilities in the production of die casting dies for forming complex surface detail without the usual engraving or pantographic reproduction of a master pattern.

When a hole is to be cut in a piece of cemented carbide, whether it be round or some complex shape, the die sinker had two choices. The die could be made by a hot pressing method and the cavity finished by grinding to exact size and finish. The die could be machined in the semi-sintered condition, then a final sintering given it and the cavity finished as to size and surface by grinding. Both of these methods are expensive and in many cases would not give the desired results.

With the Cavitron process a piece of solid cemented carbide can have a hole of any desired contour and size (between .007 and 2 inches) cut in it quickly and cheap-

SIMPLIFY PNEUMATIC DESIGN

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ly. The final impression is accurate to .002 and has as fine a surface finish as can be secured by grinding.

Hardened steel dies present much the same problem. Holes of almost any shape or size can be burned in, but in doing so the desirable physical characteristics of the hardened steel are lost.

The Cavitron process, however, is a new tool in the hands of the die maker. . Using a blunt tool of the desired shape a hole can be cut in any material. This latest child of ultrasonics makes use of high frequency (27,000 cycles per second) pulsations.

A high frequency oscillator increases and decreases the flux in a magnetic field set up around a nickel rod. This change in flux causes an alternate expansion and contraction of the nickel rod which, in turn, imparts a reciprocating motion to the formed tool connected to it. The rapid vibration, 27,000 times per second, imparts to the tool an acceleration of approximately 70,000 times the acceleration caused by gravity.

The work to be perforated is placed beneath the tool so that the pulsating motion is transferred to it. At the same time a suspension of some inexpensive abrasive such as boron carbide flows over the work. The action of the tool is such that minute chipping action occurs. No appreciable heat is generated during the process so that there is no structural change in the material being cut.

The finish depends entirely on the abrasive used. For rough finishes a 240 mesh abrasive is used, while for smoother finishes and closer tolerances 280 mesh or finer is used.

For work to the closest tolerances a roughing cut is generally made using a formed tool and a rather coarse abrasive. A second finishing cut is then made with another tool and a finer abrasive. Tolerances of less than .002 can be secured by this procedure.

An example of the speed of this process is the cutting of a ¼ inch square hole in a cemented carbide plate ¼ inch thick in about one-half hour. Less time would be required for a round hole.

Tools for the Cavitron are simple and can be made to the desired shape from almost any metal such as cold rolled steel. No cutting edge is needed and all tools have blunt ends.

Maintenance of the machine is said to be light as few parts are exposed to wear. All rough treatment is taken by the form tool and the abrasive. The machine is virtually self operating once it is set up so that little skilled labor is required.

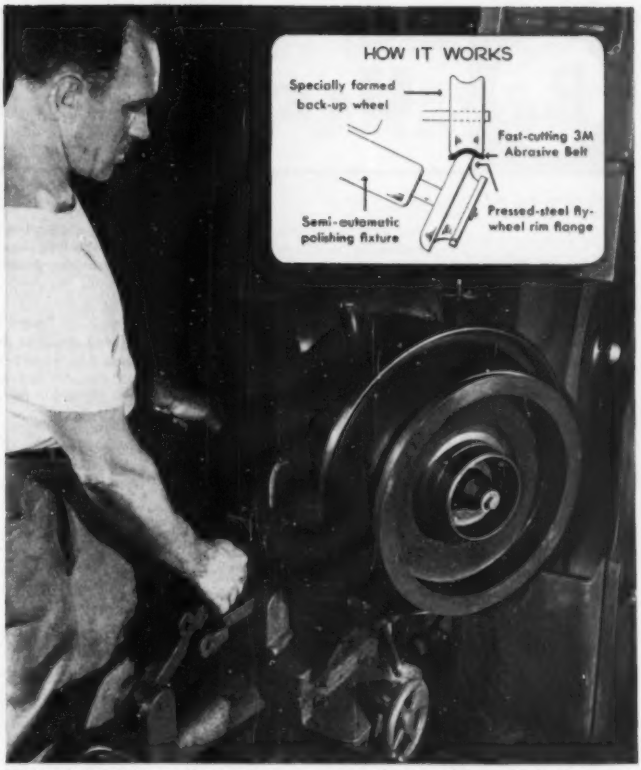
In operation, a form tool is made up having the desired contour. This is connected to the nickel rod of the Cavitron and the whole suitably mounted. The work to be perforated is held in a vise which allows sufficient lateral movement for the precise locating of the hole in the work piece. The feed is generally accomplished by moving the work up. Even deep holes are self flushing so that the form tool need not be removed from the hole once penetration has started.

SIMPLE TOOLS from almost any metal, such as tool steel, are used. At **left** is shown the tool for cutting a screw thread in carbide, while at **right** is shown the tool used for cutting a square slot in carbide lying in the foreground.

For precise location of holes and impressions in dies the Cavitron head can be mounted in a machine such as a jig borer with the work on the table. The feed in this case can be either by raising the table or lowering the head.

Even threaded parts, either internal or external, can be formed. By advancing the tool and rotating the work at a suitable rate threads can be cut.

continued on page 91



SEMI-AUTOMATIC polishing fixture spins and turns 20" pressed-steel wheel against 3M belt. Back-up wheel is formed to mate with curve of flywheel flange.

"Formed-wheel" belt grinding cuts 3-step job to one!

3M ABRASIVES SLASH GRINDING TIME 71% AT AMERICAN TYPE FOUNDERS

Time study figures prove it! Formed back-up wheels and 3M Abrasives are saving American Type Founders $1.15 on every "Little Giant" press flywheel they finish. A one-step operation now gives these wheels a smoother, cleaner surface in only 7¼ minutes instead of 25 minutes with the former 3-step method, saving 71% on time alone.

Diagram above shows how formed back-up wheel matches the contour of the flywheel rim.

You can make savings in time and money on *your* heavy grinding and finishing by consulting one of our experienced Methods Engineers. No obligation! Write Dept. DC91 for this 3M consultation service.

Made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn., also makers of "Scotch" Brand Pressure-sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Adhesives. General Export: Minn. Mining & Mfg. Co., International Division, 270 Park Avenue, New York 17, N. Y. In Canada: Minnesota Mining & Mfg. Co. of Canada, Ltd., London, Canada.

For further information circle No. 97 on the Reader Service Card.

PMM USEFUL LITERATURE

For additional information on the products appearing on this and the following pages, mark the key number of the item on the card bound into this issue. Drop the card in the mail—no postage is required.

DIE CASTING

Die Casting Facilities: **No. 4**
A photographic presentation of their facilities for producing zinc and aluminum die castings is contained in a folder issued by Advance Pressure Castings, Inc. Also illustrated are some of the parts that the company has produced.

Die Casting Design: **No. 33**
"Hints for Designing Good Die Castings" is the title of a booklet offered by the Hoover Co. The booklet also shows some of Hoover's design and production facilities.

Small Interlocked Die Castings: **No. 31**
The Intercast process, used by the Gries Reproducer Corp. to produce interlocked die castings of less than 1/2 ounce in one operation, is explained in a bulletin available from the company.

Die Casting Quality Control: **No. 170**
The methods used by the Electric Auto-Lite Co. in quality control of die casting production are illustrated and explained in a catalog issued by the company. A table of alloy compositions is also included.

Design Information for Light Metals: **No. 44**
Suggestions on designing die castings for production in aluminum or magnesium are included in literature offered by Litemetal Dicast, Inc.

Dimensioning Prints: **No. 60**
"How to Dimension Prints for Die Castings" is the title of a booklet on die casting design offered by the Newton-New Haven Co. The booklet explains the methods of dimensioning that are necessary to get the best results.

Die Casting and Finishing Facilities: **No. 3**
The die casting, machining, painting and plating facilities that enable the Admiral Die Casting Corp. to deliver die cast parts ready for assembly are illustrated and described in a company brochure.

Die Casting and Permanent Molding: **No. 54**
The Monarch Aluminum Mfg. Co., which produces zinc and aluminum die castings and permanent mold castings, describes its manufacturing facilities in a folder available from the company.

FINISHING MATERIALS, EQUIPMENT, METHODS

Increased Painting Efficiency: **No. 171**
A new electrostatic paint spraying system that is said to increase painting efficiency from 25 to 75 percent over other methods is covered in a bulletin available from the Ransburg Electro-Coating Corp.

Controllable Emulsion Cleaner: **No. 172**
Super-Mul, an emulsion and solvent cleaner that can be controlled from a stable to an unstable condition by regulating the concentration, is described on a data sheet offered by the DuBois Co.

Aluminum Etching Compound: **No. 173**
An etching compound for all types of aluminum alloys that is said to eliminate the formation of scale on tanks and coils is described in a technical bulletin offered by the Diversey Corp.

Book on Barrel Finishing: **No. 174**
Barrel finishing on all types of materials is covered in a 56-page book called "Barrel-Finishing with Alundum Tumbling Abrasive." The book, available from the Norton Co., covers all phases of the process in three sections.

Thread, Plug and Ring Gages: **No. 175**
Thread, plug and ring gages for use in checking production accuracy are shown and described in a catalog offered by the Republic Gage Co. The catalog includes the purpose of each gage and how it is to be used by the inspector.

Booklet-Wall Chart on Metal Finishing: **No. 176**
Case study discussions of metal finishing problems and their solutions are included in a booklet titled "Blueprints for Faster, Better Production", available from the Behr-Manning Corp. The booklet can be folded out into a wall chart.

Die Milling Machine: **No. 177**
An 8" x 18" tool and die milling machine which can be used to produce die casting dies and molds for wax or plastic injection is described in a Cincinnati Milling Machine Co. publication.

Types of Metal Soil and How to Clean Them: **No. 178**
"Some Good Things To Know About Metal Cleaning" is the title of a booklet offered by Oakite Products, Inc. The booklet discusses the various types of soils imparted by metal fabricating processes and recommends compounds and treatments to remove these soils.

Black Oxide Process for Iron and Steel: **No. 99**
Black Magic (Type A), a black oxide coating process for use on iron and steel parts, is described in literature offered by the Mitchell-Bradford Chemical Co. Only one salt, used in one tank, is required for application of the coating, with other tanks for rinsing and alkali cleaning.

Electroplating Barrels: **No. 179**
Two barrels, Type H and Type OLS, for use in electroplating are described in folders available from the Dantels Plating Barrel & Supply Co. Complete descriptions and specifications for both machines are given in the folders.

Piston Relief Grinding: **No. 180**
A method of using a master cam to grind various relief angles into the skirts of aluminum permanent mold pistons is described in the June, 1951, issue of Grits and Grinds, a Norton Co. publication. The company manufactures abrasive grinding equipment.

Easily Applied Metallic Labels:
Metal-Cals, which are metallic labels that can be applied in a manner similar to those used with cellophane transfers, are covered in literature available from the C & H Supply Co. The labels are made of .003 aluminum foil, will adhere to metal surfaces and will take additional information applied with a typewriter.

Low-Temperature Brazing with Pre-Forms: **No. 182**
Pre-formed shapes of low-temperature silver brazing alloy are shown in a pamphlet offered by Handy & Harman. The shapes can be placed at the joints to be brazed, thus speeding the operation.

INVESTMENT CASTING

Close Tolerances with Strong Metals: **No. 183**
The process used by the Adapti Co. to achieve precision casting with strong alloys is described in a 4-page company bulletin.

Investment Waxes: **No. 184**
"Dependable Waxes for Industry" is the title of a leaflet offered by the International Wax Refining Corp. The booklet lists the chemical composition and physical properties of a number of wax compounds.

Investment Casting Facilities: **No. 185**
The facilities and equipment of the Kerr Mfg. Co., as well as drawings and pictures of a number of parts produced by the investment casting process, are shown in a leaflet offered by the company.

Cutting Costs, Speeding Production: **No. 38**
The advantages and applications of the "lost wax" method of precision investment casting are reviewed and discussed in a bulletin put out by the Investment Casting Co. In one section the complete process is shown pictorially.

Case Histories: **No. 36**
Five case histories are among the material included in a pamphlet offered by the International Nickel Co., Inc. Also in the pamphlet is a reprint of an article on the company's plant and casting process.

Frozen Mercury Process: **No. 186**
The frozen mercury pattern process as used by the Alloy Precision Castings Co. is described in a booklet offered by the company. The booklet also shows how "booking" is possible with frozen mercury, making possible the one-piece casting of difficult shapes.

Investment Casting Reprints: **No. 14**
Reprints of articles on investment casting from various technical magazines are offered in a folder by Arwood Precision Casting Corp. Several of the articles were written by company engineers.

Design Possibilities: **No. 187**
The possibilities in tolerances and shapes using Stellite and other high strength alloys in investment casting are shown in a bulletin available from the Haynes Stellite Co. Parts and dimensioned drawings are shown, with notations about the special features of each example.

Small Pattern Molding Machine: **No. 188**
A small injection molding machine that can be used to make plastic patterns for investment castings is described in a data sheet offered by the Moslo Machinery Co.

Investment Casting Equipment: **No. 71**
Equipment and supplies necessary for precision investment casting are shown and tabulated in a booklet titled "Modern Precision Investment Casting," offered by Alexander Saunders & Co.

Investment Casting Patterns: **No. 84**
Molding machines which make styrene patterns for precision investment castings are illustrated and explained in a bulletin published by the Van Dorn Iron Works Co.

Investment Casting Cost Data: **No. 189**
Tooling and production data, cost estimation and application suggestions are contained in a bulletin offered by the Hitchiner Mfg. Co.

Small Investment Castings: **No. 190**
Investment castings of high melting point, non-forgeable, hard-to-machine alloys are shown in a 16-page booklet offered by the Microcast Division, Austenal Laboratories, Inc. Also shown are simplified assemblies in which several machined parts are combined as one investment casting.

METALS AND MELTING EQUIPMENT

Melting and Holding Furnaces: **No. 191**
Low frequency induction furnaces for melting and holding aluminum, copper, zinc and their alloys and for superheating and melting cast iron are manufactured by the Russ-Holt Corp. A continuous casting unit is also available with the furnaces.

continued on page 73

Your best bet's

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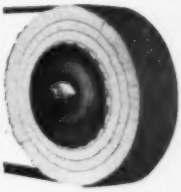
for

ZIPPO BUFFS

These famous long-wearing buffs run cool under all buffing conditions. Constructed of high count bias-cut cloth mounted on safe steel centers. Available in a wide range of densities and center diameters.



for

STYLE C-20 CONTACT WHEELS and F-26 Belt Lubricant

A C-20 flexible Contact Wheel will form itself to the shape of the work and permit the abrasive belt to polish contoured surfaces and F-26 Abrasive Belt Lubricant will increase belt life by preventing loading and glazing. Produces finer, smoother and brighter surfaces through lubrication.

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A complete line of production buffing compounds. Produced in bar and tube form. Formax is the originator of the "Spraymax" Liquid Compounds for brush or spray application.

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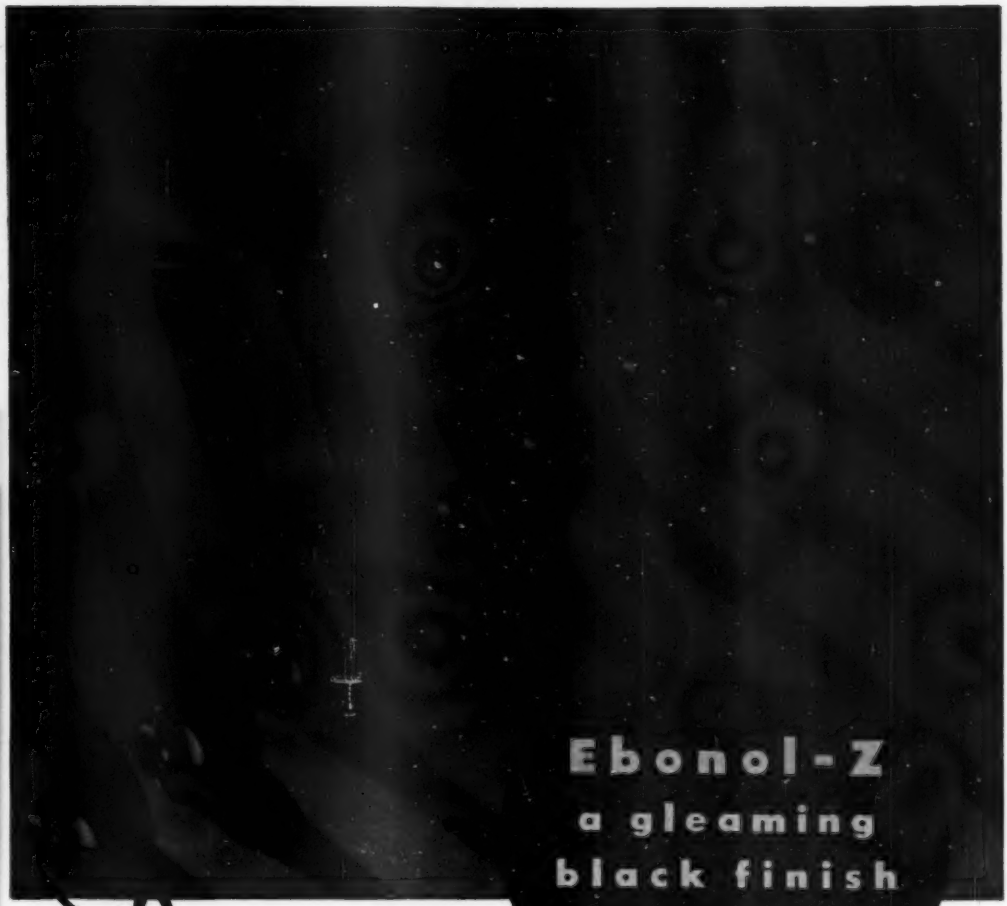

Beautiful, jet-black, like polished Ebony

These zinc automobile door handles are typical of the products processed in Ebonol-Z. This simple, one-dip method imparts to zinc base diecastings and plated parts, a rich, adherent black coating with good weathering qualities. Parts need only to be cleaned and then treated for a few minutes in a warm solution of Ebonol-Z. Chemical cost is one-half cent per square foot of the area coated . . . cheaper than plating or painting. Now used for finishing war materiel, and typewriters, business machines, toys, cameras, radios, name plates, buttons, and buckles.

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○ Ebonol-Z for zinc

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For further information circle No. 94 on the Reader Service Card

METALS AND MELTING EQUIPMENT

Compact Instrument Analyzes Metals: **No. 192**
The OPL Metallograph, manufactured by the F. T. Griswold Mfg. Co., is a 12" x 12" x 18" instrument used for structural analysis of metal samples and other materials. It is described in literature issued by the company.

Guide for Induction Heating and Melting: **No. 193**
A selector chart for induction heating and melting and a table giving heating and melting speeds for standard induction heating and melting are featured in a bulletin called "Induction Heating and Melting", offered by the Ajax Electrothermic Corp.

Removes Oxides from Bronzes: **No. 194**
Oxides of aluminum, manganese and silicon can be removed from molten bronzes by the addition of Albral, a product of Foundry Services, Inc. The product, which is described in literature offered by the company, removes only the oxides from the melt, and leaves the alloy unaffected.

Furnace Information: **No. 195**
Gas fired, oil fired and electric furnaces for sintering, brazing and other industrial applications are illustrated in Bulletin No. 461, offered by the Electric Furnace Co.

Sintering Furnaces: **No. 196**
Specifications and design features of the Harper Electric Furnace Co.'s line of electric sintering furnaces are given in a folder issued by the company.

PERMANENT MOLD CASTING

Possibilities of Permanent Molding: **No. 197**
A review of the advantages of permanent mold casting in aluminum, some suggestions for designing parts for this process, tables of properties of castable aluminum alloys and pictures of some of the applications of the process are contained in Bulletin 45 PMC, available from the Per-Mold Co.

Book Compares Aluminum Casting Methods: **No. 198**
Aluminum castings made by die casting, permanent mold casting, semi-permanent mold casting and sand casting are covered in a 79-page book published by Aluminum Industries, Inc. The book discusses the advantages and disadvantages of each process as compared to the others.

Keeping Die Costs Low: **No. 199**
The method used by the Michigan Wheel Co. to keep the customer's die costs to a minimum are illustrated and described in a folder offered by the company.

PLASTER MOLD CASTING

Foundry Practice Shown: **No. 200**
Castings in a number of alloys, as well as the complete production process from pattern making to metal pouring, are shown in a booklet about plaster mold casting offered by the Universal Castings Corp. Included with the booklet is a chart of the properties of the alloys cast by this company.

Permeable Casting Plaster: **No. 201**
P-M-C metal casting plaster is described in Bulletin No. ILG-32, available from the United States Gypsum Co. The plaster is said to have a controllable permeability.

Close Tolerance Casting: **No. 202**
A number of cylindrical castings on which tolerances have been held to ±.005 are shown in a folder offered by the Eclipse-Pioneer Div., Bendix Aviation Corp.

Plaster Mold Casting Applications: **No. 15**
The various uses and applications of plaster mold castings in industry are illustrated and explained in a booklet titled "Quality Precision Investment Castings For Industry", which is available from the Atlantic Casting & Engineering Corp.

POWDER METALLURGY

Self-Lubricating Parts: **No. 11**
Self-lubricating bearings and machine parts are shown and their advantages explained in a bulletin available from the Amplex Div., Chrysler Corp.

Designing Powder Metal Parts: **No. 203**
Suggestions on designing powder metal parts and physical properties of several metal powders are contained in a leaflet offered by the Powdered Metal Products Corp.

Analyzing Particle Size: **No. 204**
Analyzing the particle size of metal powders finer than 200 mesh and greater than colloidal size with the Roller Analyzer is explained in a folder offered by the American Instrument Co., Inc.

Lead-Bronze Bearings: **No. 205**
Powder metal bearings made of a copper-tin-graphite-lead alloy are described in a booklet published by the Johnson Bronze Co. Tables of standard sizes and dimensioned drawings are included.

Blenders and Sifters: **No. 206**
Sifters for separating metal powders and blenders for mixing and blending powders of different composition and size are illustrated and described in a Bulletin No. 382, offered by the J. H. Day Co.

Powdered Metal Applications: **No. 207**
A number of parts fabricated by powder metal metallurgy are shown and information about them given in each issue of the Metal Powder Press. This publication will be sent to qualified persons in industry by the New Jersey Zinc Co.

Metal Powders: **No. 57**
A number of metal powders are reviewed, together with applications for each of them, in Bulletin 567, issued by the Plastic Metals Div., National Radiator Co.

Metal Powder Terminology: **No. 208**
An index of terms used in powder metallurgy is included in a booklet on designing powdered metal parts which is available from the Wel-Met Co.

Powder Metal Presses: **No. 209**
Presses for making powder metal parts and accessory equipment for the presses are shown in a 32-page catalog offered by the Kux Machine Co. Complete data is included on each machine.

Metal Powder Plant Described: **No. 48**
The plant facilities and products of the Metals Disintegrating Co. are described in a 16-page booklet available from the company. The booklet includes pictures of the company's labs and describes the part that they play in metal powder production.

Bearings and Intricate Parts: **No. 210**
Various types of bearings and intricate structural parts are illustrated and described in a bulletin offered by Powder Metal Products, Inc. The booklet also gives specifications of company alloys and the tolerances which they are prepared to hold in production.

Calculating Bearing Loads: **No. 211**
Permissible loads on powdered metal bearings manufactured by the Keystone Carbon Co., Inc. can be calculated on a graph included in a company catalog. The catalog shows and describes bearings and other powdered metal parts made by the company.

Lubricant-Retaining Bearings: **No. 212**
Lubricant-retaining bearings and other powdered metal parts are shown and described in a catalog available from the Bound Brook Oil-Less Bearing Co. The company also makes structural parts of iron powder.

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2½¢ per hour *
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For further information circle No. 93 on the Reader Service Card.

DEFENSE CHIEF C. E. WILSON TO ADDRESS METALS CONGRESS

Defense Mobilizer Charles E. Wilson has accepted the invitation of the American Society of Metals, 7301 Euclid Avenue, to be the major speaker at the closing session of the World Metallurgical Congress in Detroit on October 19.

William H. Eisenman, the Society's Executive Secretary, said Wilson will speak on the strategic importance of world metal conservation and production to the interests of defense.

The Metallurgical Congress is sponsored by the American Society for Metals and will be the first world meeting of metal specialists and production chiefs. It will be the largest industrial gathering ever held. More than 35,000 persons are expected.

EUROPEAN MISSION TO ATTEND MEETINGS

The Economic Cooperation Administration and the Organization for European Economic Cooperation have contracted to sponsor three more "technical assistance missions" for inclusion at the World Metallurgical Congress.

More than 400 E.C.A. and non-E.C.A. metallurgists from 21 nations now are expected in Detroit. The Society already has arranged "Study Tours" of American industry which will carry 200 of these visitors through 57 cities and 13 states.

New! **BLACK OXIDE PROCESS for STEEL and IRON**

BLACK MAGIC (TYPE A) Pat. Pending

★ **Easily blackens heat treated parts.** BLACK MAGIC Type A overcomes the difficulties normally present in applying a black oxide finish to cyanide hardened pieces, which have been oil quenched, and carbo-nitrided parts.

★ **One bath! One salt!** BLACK MAGIC Type A blackening process requires only 1 bath. The same salt mixture that makes up the initial solution is used to replenish dragout losses, thus maintaining at all times a true, chemically balanced BLACK MAGIC solution. Only 6½ lbs. of BLACK MAGIC salts are required to make up each gallon of solution.

★ **Lower operating temperature.** BLACK MAGIC Type A solution is operated at a boiling point of only 290° F. This substantially decreases the amount of dragout and effects important savings in heat consumption. The higher fluidity of the BLACK MAGIC solution lowers operating costs considerably.

★ **Self rectifying.** BLACK MAGIC Type A overcomes the normal tendency in black oxide processes to build up red iron oxide in colloidal form which eventually clings to the processed work. BLACK MAGIC is so formulated to be self rectifying and under normal and many abnormal conditions will keep the bath in excellent operating condition at all times.

★ **Faster blackening cycle.** Production baths of BLACK MAGIC Type A show a decrease in the blackening time cycles of from 15 to 20%. This is an important factor in speed up in production and lower cost of operation.

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ALBERT LEA, MINNESOTA

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PMM NEW PRODUCTS

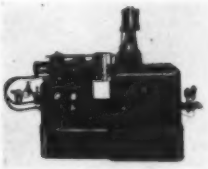
For additional information on the products appearing on this and the following pages, mark the key number of the item on the card bound into this issue. Drop the card in the mail — no postage is required.

AIR-OPERATED DIE CASTING MACHINE

Die Casting Machine

A. B. C. Die Casting Machine Co.

SPECIAL FEATURES. This is an air operated zinc die casting machine with completely automatic cycling. The machine is capable of a free cycling speed over 1000 shots per hour.



SPECIFICATIONS: The machine will produce castings up to one pound. Die blocks can be used from 1½" to 3" thick and with outside dimensions of 8" x 10". Adjustable timing dwell on the opening and closing of the toggle and injection of the molten metal. Pot capacity is 200 pounds.

For further information circle No. 144 on the Reader Service Card.

SELF-CONTAINED SPRAY PAINTING MACHINE

Automatic Spray Mask Painting Machine

Sepanski & Associates

SPECIAL FEATURES: No spray booth is required to use this machine. Only an exhaust duct, an air line and a paint supply are needed. Parts are held against a mask and a foot pedal operated. The painting cycle is then completely automatic.

SPECIFICATIONS: Automatic spray guns within the machine are pneumatically moved parallel to the surface being painted. The guns are adjustable for spray density and for any angle between 0 and 30 degrees. Angle may be set to change during cycle to assure even distribution to sides and corners. Timers integral with the machine keep cycles constant in length.

For further information circle No. 145 on the Reader Service Card.

WAX INJECTION MACHINE

Finelt Universal Wax Injector

Arofine Products Co.

SPECIAL FEATURES: This device has been designed to inject wax into molds to make wax patterns for investment casting. It allows the use of rubber molds, and operates on air pressure, hydraulic pressure or a combination of the two. Temperature can be controlled within one degree.

SPECIFICATIONS: 350 watt element operates on either 110 or 220 volts, AC or DC. Built-in thermometer has armor shield. 600 to 1000 average size wax patterns can be made with one loading. Requires 10" of bench space. Machine can be pre-heated and in 20 minutes, drained and refilled in 60 seconds.

For further information circle No. 146 on the Reader Service Card.

CORROSION-RESISTANT COATING

Anchorite 100

Octagon Process, Inc.

SPECIAL FEATURES: This is a phosphate compound for treating both ferrous and non-ferrous parts to produce a non-conductive, corrosion resistant phosphate surface that can also serve as a base for paint. Adaptable to either the immersion or spray process, depending upon production requirements.

SPECIFICATIONS: Solution is made by adding the compound to water. Five mild steel tanks are needed if the parts are to be treated by immersion. Meets the specification for a Class C (Type II) finish in U. S. Army Spec. No. 57-0-2C, armed services specification JAN-C-490, Grade I and Class A and B finishes in U. S. Army Spec. No. 57-0-2C, Type II.

For further information circle No. 147 on the Reader Service Card.

SOLVENT CLEANER FOR BUFFING COMPOUNDS

Dynakleen

Du-Lite Chemical Corp.

SPECIAL FEATURES: This cleaner was designed to remove buffing and drawing compounds quickly from knurled or fluted surfaces of all metals. Can be used to remove all types of soils from metal surfaces.

SPECIFICATIONS: No heating or other special tanks are required. Can be used in spray washing machines or applied by hand. It is a fast-drying safety solvent, and the manufacturer claims that it can be used repeatedly with only occasional filtration.

For further information circle No. 148 on the Reader Service Card.

CHROME PLATING WITHOUT NICKEL

White Brass Plating Process

E. I. du Pont de Nemours & Co., Inc.

SPECIAL FEATURES: This process has been developed by the company to enable manufacturers to use a white brass alloy as a base for chromium plating. No nickle is required in the process.

in BURNISHING MATERIALS

it's the SHAPE that counts!

Thousands of small parts, stampings and castings are burnished quickly and efficiently with Abbott Burnishing materials. They're shaped to do the job *right!*

Abbott Burnishing Shapes — Ball, Ovalball, Cone, Diagonal, Pin — are scientifically designed to make effective contact on parts of of any size and shape. Each is made from Abbott's famed bearing ball steel, deep hardened and polished to a mirrorlike, glass hard finish.

If you have a burnishing problem . . . make use of Abbott's 40 years of barrel finishing knowledge. Write today.

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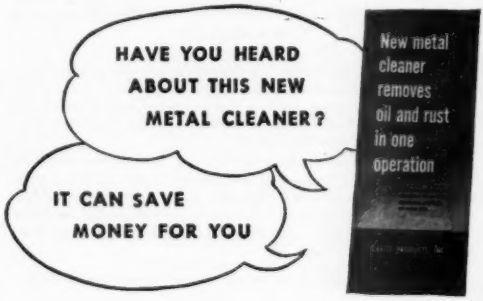
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IT CAN SAVE MONEY FOR YOU
New metal cleaner removes oil and rust in one operation

Oakite Compound No. 33 removes oil *at the same time* that it removes rust. And *at the same time*, it prepares metal for painting.

It's a great soak cleaner for steel, cast iron and aluminum; and great for hand-swabbing on metal surfaces too large to be soaked in tanks. *It frequently eliminates pickling operations on moderately rusty steel.*

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Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

For further information circle No. 100 on the Reader Service Card.

The process is said to give a plate that is indistinguishable from the standard chrome plate.

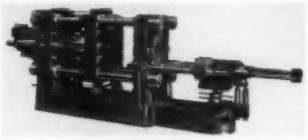
SPECIFICATIONS: The white brass used in the process is an 80/20 zinc-copper alloy which is electrodeposited from a cyanide bath using special brightening agents. Although extensive research is being carried on to adapt the process to production quantities, the company emphasized that there are still a number of technical obstacles to be overcome.

For additional information circle No. 149 on the Reader Service Card.

EUROPEAN DIE CASTING MACHINE

Triulzi Die Casting Machines
Officine Ambrogio Triulzi s. r. l.

SPECIAL FEATURES: Machines are built with locking forces of 30, 55, 100, 200, 400 and 700 tons. Total locking power is exerted on the dies only during the injection period. Injection piston has variable speed stroke with highest speed at the end of the injection stroke. Push-button or lever controls may be specfied. All parts subject to wear are hard chrome plated.



SPECIFICATIONS: The following are specifications for the 400 ton machine; Locking pressure, 407.4 tons, Injection pressure max. 82,400 psi, working pressure 2.130 psi, plate size 44" x 53", space between bars 29½" x 20½", max. clearance between plates 44", min. clearance without support 18", min. die plate size 14" x 14", plunger stroke 19½", die opens 26".

For additional information circle No. 150 on the Reader Service Card.

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IN PRECISE MOUNTS ON LATHES AND OTHER MACHINE TOOLS, PRECISE GRINDER-MILLERS WITH 1/4 H.P. AND SPEEDS FROM 20,000 TO 45,000 R.P.M. DO THE WORK OF SINGLE-PURPOSE MACHINES COSTING 100 TIMES AS MUCH!

VERSATILITY. For cylindrical, internal, external and form grinding; for milling with H. S. steel or **tungsten carbide** midget mills; for micro-finishing and polishing. Use on wood, glass, rubber, plastics, or any metal including the hardest alloy steel.

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ATTACHABLE COOLFLEX SHAFT (optional). Quickly attached for bench work and handtool applications. Same speeds, same precision quill as in PRECISE GRINDER-MILLERS.

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PRECISE GRINDER-MILLERS

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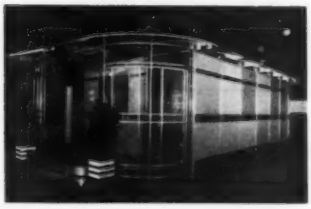
PREFABRICATED CONSTRUCTION
continued from page 35.

whether it occurs inside or outside the building. Up to three cavities can be provided in a six inch wall.

All exterior cladding and interior lining materials other than insitu construction, are fully prefabricated and finished at the factory and require no tools for fixing, each section being automatically locked and tightened by the next section above. They can be just as easily and quickly removed thus permitting expansion of the building in any direction as need may determine. No skill at all is required to assemble a complete building, but as all parts are precision made care must be taken to provide accurate foundation work. Given this, erection of a complete building by two or three unskilled workers in the course of a week-end is easily possible.

The strength and rigidity of structures built with the Keylock system are well above the values in similar wood-framed buildings. The higher strength of the aluminum alloy used as compared to wood accounts for some of this superiority, the rest being obtained through the built-up beam structure, which is much stronger than a wood beam having the same *solid* cross-sectional area. The table of strength values for various uniformly-loaded beam sections which accompanies this article will confirm this statement.



COMPLETELY PRE-FABRICATED at the factory, this outdoor exhibit booth was erected at the site by four unskilled workers in three hours.

Althought the Keylock system is comparatively new, it has had wide application in Great Britain, and from all indications will continue to grow in acceptance there. The introduction of the system by James L. Erickson Sales, Inc., of Dayton, Ohio, should prove helpful in the construction of pre-fabricated and normally constructed small shops, office buildings and warehouses, homes, additions and garages, since it eliminates much of the skilled labor cost normally associated with such construction.

ONLY ONE ANSWER—
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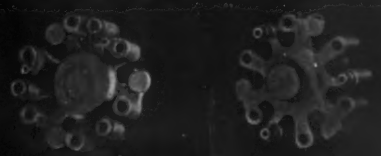

THE terminal insert illustrated is one of Arwood's outstanding achievements. It represented a real challenge to produce the die and to successfully cast the insert in bronze.

The insert was designed for investment casting and it is an application that is almost impossible to produce by conventional production methods.

Interesting to note are the six .070 diameter holes, the three .039 diameter holes and the .050 arms connecting the bosses to the hub —all cast to maximum tolerances of .002.

Perhaps you have a production problem that Arwood can help you solve. Our engineers, with years of experience in many industries, often are able to make valuable suggestions that result in important savings in manufacturing.

For more complete information about the accuracy, the lower costs and the versatility of precision casting, write for our booklet, "A Critical Survey of Investment Castings."

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PRECISION CASTING CORP.
72 WASHINGTON STREET • BROOKLYN 1, N. Y.
Plants: Brooklyn, N. Y., Groton, Conn., Tilton, N. H.

For further information circle No. 14 on the Reader Service Card.

OPPORTUNITIES

FOR SALE — One nearly new Cleveland Automatic die casting machine No. 400. Must sell at once. Write Precision Metal Molding, Box 9351.

MANUFACTURER'S REPRESENTATIVES — now contacting product engineers and buyers and are familiar with die castings or allied lines will find the rapidly expanding field of lost wax investment castings a profitable addition to your present lines. We have openings in several industrial centers. Write for information and tell us your qualifications. The Adapti Company, 2996 E. 72 St., Cleveland, Ohio.

DIE MAKER— DIE CAST—We are in need of an experienced man, willing to locate in a small town in Western Pennsylvania to take over the running of a tool room in a small but progressive die cast plant. Work will consist of die repair and some new work. Please give complete details in your reply. Write Precision Metal Molding, Box 9251.

METALLURGIST, under 35, ferrous and non-ferrous, precision investment casting experience preferred, excellent opportunity in growing mid-western plant. Write to PRECISION METAL MOLDING, Box 9451.

DIE CASTING FOREMAN—an experienced and ambitious man willing to associate himself with a small but progressive organization, where there is an opportunity to purchase an active interest if desired. Plant situated in a small town in Western Pennsylvania. Please give complete background in reply. Write Precision Metal Molding, Box 9151.

WANTED

An outstanding opportunity is offered to an experienced General Manager for a new, modern raw and finished zinc and aluminum die casting plant located in the middle west. Write PRECISION METAL MOLDING, Box 9551.

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PMM INDUSTRY NEWS

DOLLIN CORP. APPOINTS PITTSBURGH REPRESENTATIVE

The Dollin Corporation, Irvington, N. J. producers of zinc and aluminum die castings, have announced the appointment of Edward A. Linhart, 123 Seminole Drive, Pittsburgh 28, Pa., as the Dollin representative for the Pittsburgh area.

MAGNETIC POWDERS, INC., MOVES

Magnetic Powders, Inc., formerly located at Stamford, Conn., have announced that they have moved into a new plant and offices located at Johnsonburg, Pa. Mail address is listed as P.O. Box 247.

WEL-MET BUILDS NEW PLANT

A new plant will soon be constructed by the Wel-Met Co., producers of self-lubricating bearings and structural and mechanical parts made of sintered metal powder. The new plant, which will be operated in addition to the company's present plant at Kent, Ohio, will triple the company's productive capacity. According to Thomas L. Robinson, president of the company, the new plant will add 100 employees to the 125 people already working for the Wel-Met organization.

MICHIGAN POWDERED METAL IS ACQUIRED BY ALLIED

Michigan Powdered Metal Products Co. has become a subsidiary of Allied Products Corp. of Detroit, as the result of acquisition of all outstanding stock of Michigan Powdered Metal.

HITCHINER EXPANDS PLANT FOR INVESTMENT CASTING

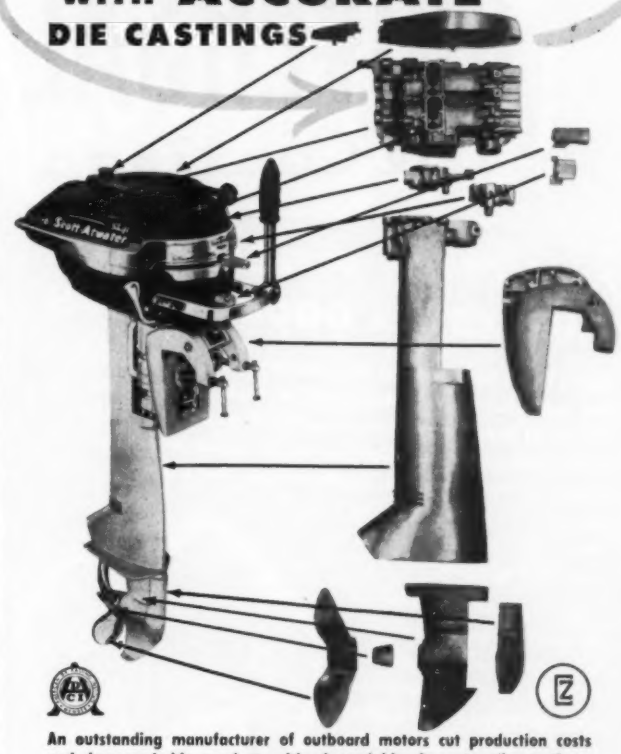
To serve a growing number of users of precision investment castings, the Hitchiner Manufacturing Company, Inc., has moved from its plant in Manchester, N. H., to a new and larger factory in Milford, N. H.

PLANT ADDITION GIVES DOUBLED CAPACITY

International Powder Metallurgy Co. of Ridgway, Pa., is now constructing an addition to its plant which will double its production capacity. The company manufactures bearings, bushings and powdered metal parts.

Recently elected officers of the company are: M. T. Victor, president; E. G. Smith, vice president; R. A. Trimble, executive vice president; G. J. Hoehn, treasurer and H. J. Hoehn, secretary.

CUT PRODUCTION COSTS WITH ACCURATE DIE CASTINGS



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For further information circle No. 2 on the Reader Service Card.

STRUCTURAL PARTS
continued from page 47

ness is desirable.

It is possible to carburize such parts and increase the physical properties somewhat, but generally speaking, stresses, and where a part of low-hard- the process is not desirable.

Tolerances can be held as closely on these parts as on any others, and by the use of a coining operation after sintering, dimensional variations can be held to less than 0.001 inches. It is usually best to make these parts from a hydrogen-reduced iron powder.

Copper impregnated iron parts do not respond readily to blacking, but can be nickel plated or chromium plated. They respond readily to soft soldering, silver soldering, and brazing, but do not weld satisfactorily.

Of the low porosity materials, copper-impregnated iron compacts are among the cheapest, since they can be produced very rapidly at low forming pressure, and do not require as ruggedly constructed dies in their fabrication, the low porosity being achieved, of course, by virtue of the copper, which fills all of the interstices during sintering.

PURE IRON COMPACTS

Everything that has been said above about copper-impregnated iron parts is equally true of parts made of pure iron. It is, however, more difficult to secure low porosity at low cost when made of pure iron. Unless it is desired to make an alloy steel or a plain carbon steel part, the designer should generally expect that parts made of pure iron will be somewhat porous, the porosity running from 10 to 30 percent. Pure iron compacts, whose density is substantially the same as that of wrought iron, can be made, but these parts require an extremely high forming pressure, with associated shorter die life.

Parts made of pure iron have about the same physical properties as copper-impregnated iron parts. Hardness, as a rule, is a little lower, and elongation and reduction in area may be somewhat higher. If, however, very high forming pressures are used, so that the finished part has essentially the same density as wrought iron, then the parts after sintering will show a very materially higher elongation and reduction in area, but will still have a relatively low tensile strength.

Pure iron parts, as in the case of copper-iron parts, respond to standard joining methods, and in this case, respond readily to welding, either gas or electric.

All normal surface finishing procedures can be used, if the density of the part is high enough. On porous parts, however, considerable difficulty may be expected in plating operations, due to the porosity of the part.

In the case of pure iron parts, the magnetic characteristics are often of considerable interest. Unless specially made, parts made from iron powders do not have as desirable magnetic characteristics as fully annealed, pure iron made in the more orthodox manner as, for example, fully annealed

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Armco iron. In many cases, however, the magnetic properties of pure iron compacts are sufficiently good to allow their use when the manufacturing economy is such that the use of a part made from metal powder is indicated. Each one of these cases, however, should be investigated before a decision is made.

PLAIN CARBON STEELS

Plain carbon steels can be made from metal powders by two or three well-known processes. As generally made, carbon content will run up to about 0.9 percent. The density will vary from 5.5 to 7.5 grams per cc. The ultimate tensile strength, as annealed, from 28—85,000 psi. The elongation from 2—5 percent in 2", and the Brinnell hardness from 50 to 160.

These steels, if they contain some manganese can be hardened in the normal manner, and their physical properties will increase about the same amount on hardening and tempering as will wrought plain carbon steels. Hardnesses as high as 63—65 Rockwell C, with ultimate tensile strength of 150,000 psi have been secured. These properties, however, are only developed when the compact is of very low porosity.

Wear resistance of plain carbon steels made from sintered metal is not as good as the wear resistance of corresponding materials made by the more usual manufacturing methods. They can be used in structural parts that are moderately high-stressed, both in tension and compression, but care should be exercised in applying them indiscriminately to replace ordinary carbon steel. They are not suitable, as a rule, for use as cutting tools. As in the case of pure iron compacts, all of the usual joining and surface finishing processes can be employed.

ALLOY STEELS

Alloy steel parts can be made by powder metallurgical techniques, and the usual range of alloying elements can be employed. Generally speaking, the alloying elements are added in the form of powdered ferro-alloys, the carbon content of the ferro alloy depending on the final carbon content in the desired part. If higher carbon is desired than can be secured from the ferro alloys, the part can be sintered in a carburizing atmosphere to give the desired carbon content.

As an example of the alloy steels that can be made from metal powders, a composition containing 2 percent nickel, 1 percent chromium, 0.5 percent carbon (SAE 3250) is readily made, and after oil quenching from 1650 F and tempering at 500 F exhibits an ultimate tensile strength of 110,000 psi.

In another case, 3.5 percent nickel, 1.5 percent chromium, 0.4 percent carbon (SAE 3340) as sintered and fully annealed, has a tensile strength of 73,000 psi, and after proper hardening and tempering, has a tensile strength of 166,000 psi. These two steels are merely typical of what can be made from metal powders.

In some cases, the powder part shows superior characteristics to a standard part of the same composition. As an example, consider a manganese-molybdenum steel having a density of 7.82 grams per cc. The tensile strength of a part made from powder is 124,000 psi as compared

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These powders are manufactured in granular, nodular, spherical and flake forms in various particle sizes.

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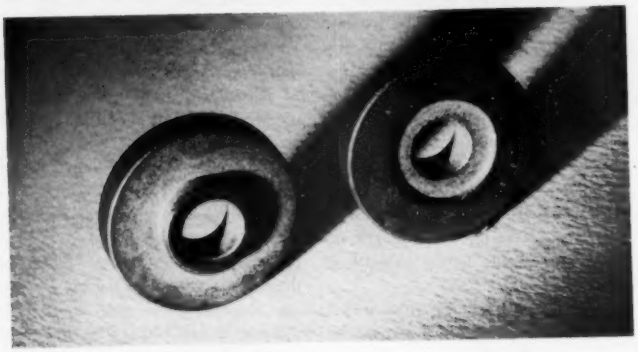
Powder Metal Parts Like These...



SAVE MONEY... MAINTAIN PRODUCTION

Shown above are powdered iron rollers which are used in file cabinets. Steel ball bearings were formerly used. Not only has the porous iron bearing provided a quieter, freer moving drawer but the price of this part is considerably lower than a ball bearing. International Power Metallurgy Co. would like to help you with your powder metal design problems.

THE POWDER METALLURGY ENGINEERS HANDBOOK IS AVAILABLE TO YOU. SEND FOR A COPY ON YOUR COMPANY'S LETTERHEAD.

International Powder Metallurgy Co.

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with 104,000 psi for a standard steel of the same composition. The Rockwell C hardness as annealed is 27 for the powder part, and 20 for the standard metal. As quenched, the powder part has a hardness of 66.5 Rockwell C, and the standard material 65.3. Tempered, the two materials show the same hardness—62 to 63 Rockwell C, but the powder part has a considerably higher modulus of rupture, being 603,000 psi as compared with 433,000 psi for a standard part.

Again, the alloy steel parts can be joined by any of the normal methods used for joining such parts, and respond to all of the usual surface finishing procedures, providing the porosity is sufficiently low.

In the preceding sections dealing with pure iron compacts, plain carbon steels, and alloy steels, some of the properties of these materials were listed. It should be noted that all of these materials can be case carburized, and if the composition is correct, they will respond to heat treatment, just as ordinary case hardened steels will respond to heat treatment.

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It should be noted, however, that in general case carburization tends to give a coarser grain, leading to a more brittle case than is usually secured. This drawback can be overcome if it is possible to do some cold working after case carburizing, and before hardening, as, for example, applying a coining operation before the hardening operation.

STAINLESS STEELS

Stainless steels of the usual compositions can be made from metal powder. Generally speaking, they do not exhibit quite as good resistance to oxidation, or as good corrosion resistance as their wrought counterparts. They are difficult to manufacture, and have been quite expensive. Unless a part is of such complexity that normal machining processes are too costly, it is rather doubtful if stainless steel parts made from metal powders can compete successfully with parts made from wrought stainless steel. At present, stainless steel parts are being made commercially, the greatest production being in porous parts.

BRASSES AND BRONZES

Parts made of brass and bronze can be duplicated readily by powder metallurgical techniques. When properly made, they exhibit almost the same properties as the wrought material. Generally speaking, the bronzes are more easily and cheaply made, neglecting the cost of the raw materials, since they do not require as precise a sintering procedure as the brasses.

Brass compacts tend to lose their zinc on sintering, and are, therefore, somewhat more difficult to manufacture. Compacts made from metal powders in any of the normal brass and bronze compositions can, as a rule, compete successfully with their wrought counterparts. They can be joined by soft soldering and silver soldering, and by brazing with proper brazing alloys. Low porosity parts respond well to nickel and chromium plating.

PURE COPPER COMPACTS

There is very little application of pure copper compacts to structural parts at the present time. Perhaps one of the reasons for this is that too much attention has been given to porous copper compacts, where the porosity is the desirable feature. Pure copper as a high density material, when made from powder, is generally difficult to prepare. It has a tendency to blister and to expand on sintering. High density parts, however, can be made having approximately the physical characteristics of cast copper. By suitable treatment after sintering, these parts can be improved, but it is seldom that a copper compact will have as good properties as wrought copper. Where they can be applied, however, copper compacts show a very material economy of manufacture. As in the case of brass parts, normal joining methods for copper can be applied. High density parts are easily plated in the usual manner for copper.

For further information circle No. 24 on the Reader Service Card.

FOR STRUCTURAL PARTS

produced by powder metallurgy use Hoeganaes sponge iron powder.

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Sellers of Hoeganaes sponge iron powder.

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SPECIAL MACHINES
continued from page 37

and the end flared in a flanging machine. There are 16 of these chucks in a single machine, which represents a total of 48 jaws.

This number of parts, projected over the relatively limited total annual production of such machines, is not enormous as compared with the volume of parts used for any consumer goods, but it is high enough to be entirely economical by investment casting. The very low initial cost, plus the speed with which it is possible to produce parts after the original wax mold is tooled—makes it highly suitable for such small quantities of difficult parts.

One other advantage which the investment casting process holds for the designers of such special machines is the relative freedom of shapes. Thin sections, complex contours and angles, and great surface detail are readily procured, thus freeing the designer from some of the worry over fabricating difficulties, allowing him to concentrate more fully on the functional requirements of his machine.

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   Production facilities in our new, modern plant assures you of quick service.
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   All our investments are carefully tested to assure you of uniform results drum after drum.
4. **ENGINEERING SERVICE**
   Pre-Vest engineers have over 10 years experience in the manufacture and use of industrial casting investments. The Pre-Vest laboratory is fully equipped to assist you in solving your investment problems.
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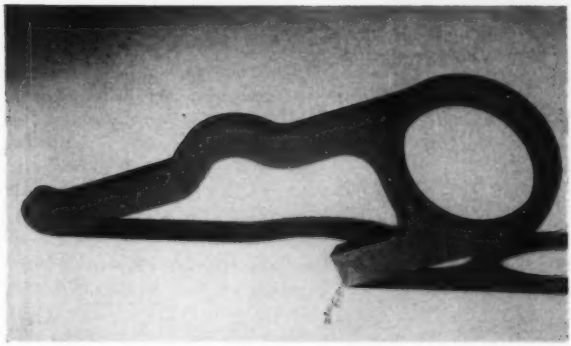
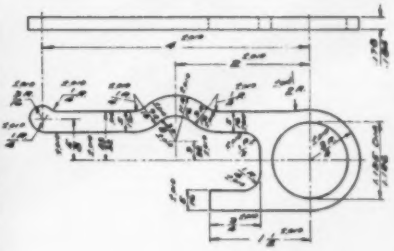
for production problems

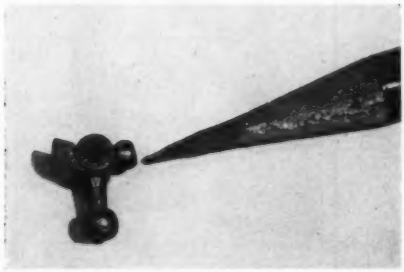




WHEN STEEL PLATE STOCK OF UNIFORM THICKNESS, **above,** proved to be difficult to get for this stitch cam follower arm, the manufacturer was in urgent need of this part to maintain production schedules. In addition, they required a bearing in one end of the part.

Amplex Division of Chrysler Corporation produced this part within six weeks, using Super-Oilite which is a bearing material, thus eliminating the separate bearing which was formerly required. Thickness tolerance and flatness were held and performance characteristics superior to those of the former part were obtained.

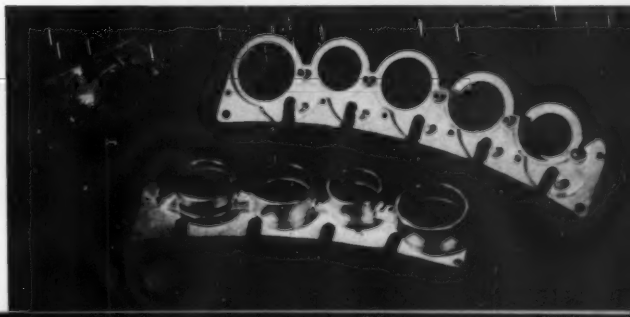
ALUMINUM BRONZE is a strong, tight, zinc-free alloy that has excellent corrosion resisting characteristics. This irregularly shaped part above in the tough alloy has been produced by casting in plaster molds by Atlantic Casting & Engineering Co.



A STAINLESS STEEL CARBURETOR PART of complex shape, above, is one of those "impossible jobs" which is now being produced by investment casting. Precision Metalsmiths turn out thousands of these tiny, stainless steel parts.

Suspended on a shaft running through the body, the part is accurately balanced. Protruding is a small knob with a slender shank. The problems of machining, stamping or fabricating this part from separate pieces can be readily visualized; the required alloy cannot be die cast. The solution for this high production item has been investment casting.

SURFACE DETAIL that simplifies assembling, and yet eliminates most machining operations, has been obtained by die casting the base for coin changers, below, in zinc alloy. Bright plating protects the surface of these hard-working devices and makes them more attractive. The coin changers are manufactured by McGill Manufacturing Co.



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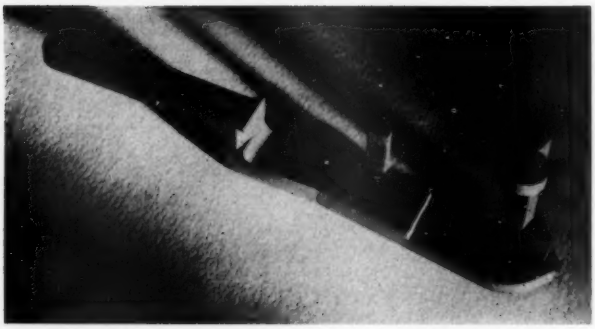
for production problems



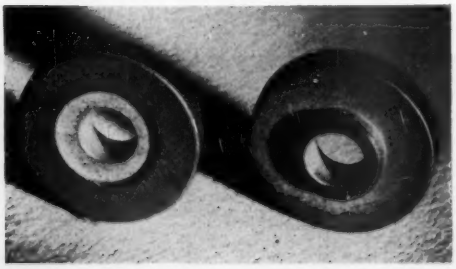
SURFACE FINISH OF 60 to 80 MICROINCHES is obtained by investment casting the small aircraft lever, **below**, in 420 stainless steel. Tolerances are held to ±.005 with several dimensions as close as ±.003 and all parts pass an aircraft x-ray examination.

Produced by Engineered Precision Castings Co., this is a good example of an investment casting application. Originally this piece was machined from bar stock, now needs only the drilling of holes.

WHERE A SAND CASTING WAS USED, for this part of a three leaf sight used on standard rifles, an investment casting has now been introduced. The result has been a reduction of machine work to the minimum, simplification of assembly, improvement in accuracy and better eye appeal.

This investment casting, produced by The Adapti Company, made it possible to market the sight for about half the price of competitive sights.

ALL MACHINING OTHER THAN FLASH REMOVAL is dispensed with by die casting two small levers in brass on the automatic sprinkler unit, below. Strength and dependability are needed in this equipment manufactured by Automatic Sprinkler Corporation of America.



IN PLACE OF BALL BEARINGS, these powdered iron rollers, left, have proved their superiority. They are produced for the file cabinet industry where ball bearings were formerly used. Due to materials shortages, they have been unable to get the ball bearings and have changed over to porous iron bearings such as these, manufactured by International Powder Metallurgy Co.

They have found that the porous iron bearing not only provides as free a moving drawer, but it is also much quieter than ball bearing and its price is considerably lower.

SMALL GEAR HOUSING
continued from page 60

of holes, it oftentimes eliminates the necessity for multiple sprues or additional feeders.

The shrinkage dimensions necessary to arrive at the desired casting sizes are usually determined by the company doing the casting and not by the company designing the part. The casting company may also suggest that in certain places it may be preferable to allow slight machining stock for cleanup.

To attain surfaces flat enough and smooth enough to provide a sealed joint, it is usually necessary to allow a small amount of stock for machining.

In any case, the design can profitably be discussed with the caster at an early stage or development so that any necessary allowances can be made, tolerances brought into conformity with process requirements, and other details worked out to make the most readily castable part. Obviously, the easier a part is for casting, the less time and labor will be consumed, the fewer rejects will be made and the lower will be the price.

CAMS, BEARINGS
continued from page 44

which holds each post from rotating; lettering and numerals to serve as calibration for the tensioning are formed in the face of the die casting.

The numerals and letters referred to above are interesting because they are recessed in the surface instead of raised. While the latter would be considerably less expensive, being machined directly into the die surface by a simple engraving on pantograph operation, the recessed lettering has been chosen because this has no edges or profiles to catch the yarn traveling over it at high speed.

The cone holder which supports the cone or "package" of yarn is also die cast, but aluminum has been used in this instance because it supports a weight cantilevered from a metal shaft, and its resistance to deformation under load is considered entirely satisfactory for the purpose.

A steel shaft is pressed into the casting to support the cone of yarn. Knurling at the lower end anchors it securely into the aluminum. Changes in the end taper on the cone holder are permitted by means of plugs in the die which permit variations in this detail, while using the die cavity for the maximum production.

PLASTER MOLD CASTING
continued from page 58

alloys provide a high strength and good corrosion resistance.

GEARS

Gears are an ideal application for the plaster mold process. Several alloys can be used for gear production, thereby permitting a wide range of mechanical properties. Hobbing, milling, and much costly machining are entirely eliminated in the production

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of bevel gears, racks, spur gears, etc. The teeth and pitch diameters are held to close tolerances and, in most cases, are ready for immediate installation. Where an application requires extremely close tolerances, the gear may have to be sized. Gears cast in plaster molds are used to replace costly cut gears in the manufacture of outboard motors, washing machines, vending machines, gas meters, communication control units, etc.

HARDWARE AND TOOLS

In addition to the mentioned applications this process is well suited for the production of hardware such as fittings, hinges, sprockets, and plumbing supplies. Sparkproof tools such as wrenches, pliers, screwdrivers, etc. which are used in explosive environments can be cast in byrillium copper or other high strength copper base alloys.

RAILROAD EQUIPMENT

The railroad industry uses many plaster mold castings such as locks, handles, lighting fixtures, ornamental and miscellaneous hardware and

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plumbing supplies. The aircraft and marine industry also utilize this process to cast hydraulic system parts, instrument fittings, control mechanisms, wing nuts, communications parts and many other larger parts.

AUTOMOTIVE INDUSTRY

The automotive industry uses many plaster mold cast parts such as bearing retainers, grill ornaments, gears, pump impellers. Plaster molds are also used to make larger body dies which are cast of a Kirksite type high strength zinc based alloy. Special dies made of aluminum alloys for the production of floor rubber mats are now successfully cast in plaster composition molds. Many of these dies will measure 6′ x 4′ in area and will have very complicated contours and must be extremely fine detailed.

Many of the tire molds used to produce the automobile tires are cast in plaster molds from special high strength aluminum alloys.

One of the most recent developments of plaster mold cast automotive parts are the various components of the Torque converter drives now being utilized in the latest model cars. These castings are very intricate and require extremely smooth impeller blade surfaces. As many as 29 separate cores must be set to form the various segments of the impeller. Close dimensional tolerances must be held to create a balanced casting.

REORGANIZE EBALOY, INC., ALUMINUM CASTING FIRM

Reorganization of Ebaloy, Inc., which had been operating under Federal Bankruptcy Act, Chapter 10, has been approved by Chicago Federal Court.

Under the plan of reorganization, parties interested in the Crucible Steel Casting Corp., of Milwaukee, Wis., will become identified with Ebaloy, Inc., of Rockford, Ill. Present management of Ebaloy, consisting of Robert H. Miller and Robert C. Lombard, will continue under the new organization.

Ebaloy, Inc., has been in the aluminum casting field since 1936, producing both sand and permanent mold castings in this metal.

PRODUCE IRON POWDER FROM DOMESTIC MAGNETITE

The production of an iron powder suitable for powder metallurgy is reported to have been obtained by the Alan Wood Steel Company from domestic magnetite ore.

In a pilot operation at its Scrub Oaks mine plant near Dover, N.J., the company is said to have produced small quantities of iron powder after six years of research and development.

The problem of producing a superconcentrate of sufficient purity to be reduced successfully into iron powder is said to have been solved on a pilot scale, with powder obtained which meets specifications for sintered iron rotating bands for ordnance.

Designs are now being forwarded for a plant capable of full-scale commercial production, although no details have been released.

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12,000 PSI YIELD STRENGTH
continued from page 59

convertible top hits the ceiling. Frame members are designed with a 12,000 psi yield strength factor.

Magnesium and aluminum have a high strength-to-weight ratio which permits exceptional design features. For reinforcement, these castings have also been designed with various types of ribbing and cross bracing as an integral part of the casting.

The alloys used are 355T6 aluminum and Dow C-HTA magnesium. Comparable typical physical properties of these two alloys are listed in Table 1.

The accuracy of the castings is so much greater than is possible with malleable castings that a number of machining operations are either dispensed with or reduced in time and labor consumption.

At the time of this writing, the use of aluminum is greatly restricted and the metal is in short supply, whereas magnesium is unrestricted and is available on the market from the secondary suppliers at a price slightly lower than the price of prime alloy ingot.

It would appear that the use of light metal castings in this application is here to stay. It is impossible to forecast which metal will prove to have the greater usage here, but the interchangeability of molds and casting equipment will give the purchaser the advantage of whatever current market conditions exist.

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MACHINING HARD METAL
continued from page 69

Typical examples of the work that has been successfully done by the process up to the present time are: engraving of lettering and numbering dies, the production of form cutters, die-sinking, machining of oil holes and keyways in hardened gears and gear cutters, manufacture of complex wire drawing dies, and the cutting of "Christmas-Tree" slots in the roots of heat-resistant alloy or ceramic buckets for jet engines.

ROBERTS ROUGE EXPANDS SALES FORCE IN 3 AREAS

The Roberts Rouge Co. of Stratford, Conn., has announced the appointment of three representatives.

The Michigan territory will be covered by James A. Dodd, who was formerly with the Detroit Chemical Specialties Co. as executive vice president. Michael C. Tamas will be in charge of the Connecticut area, while Miles K. Holcomb will be the company's New York representative.

RICHARDS PROMOTED AT BELLOWS

W. C. Richards, Jr., has been appointed executive assistant to the president of the Bellows Co., Akron, Ohio.

OVER THE FLAME
continued from page 41

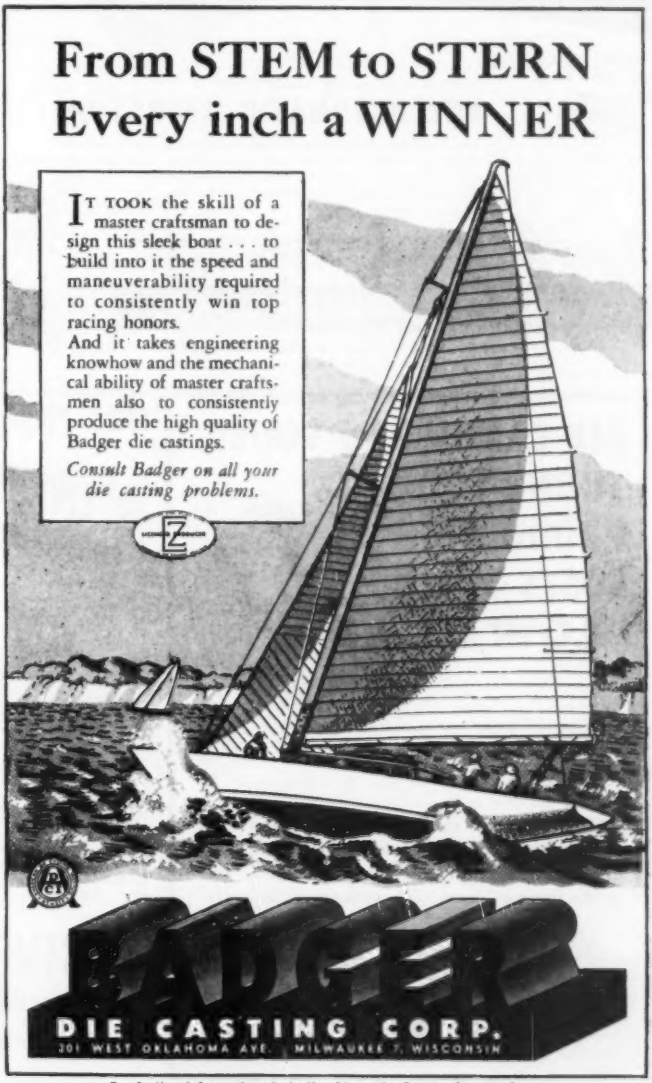
and outside wall designing tied into the method of placing the griddle on the stove. The Caloric griddle measures 11½" wide by 18" long and the illustrations indicate the steps taken to design adequate support into this griddle to maintain flatness under high heat conditions. In this respect the design of the grease trough can also be utilized to supply additional stability to the design.

The unit is designed in such a way that the grease trough is not directly over the flame. Its four small rounded legs fit around the aeration openings of the Caloric stove to make certain the griddle is accurately located over the burners.

The large open surface of the Caloric griddle combined with the additional surface supplied by the outer wall and the ribs offer ample cooling surfaces to diffuse the heat generated under high temperature cooking. Aluminum, of course, offers ideal conditions for dispersing the heat over the entire griddle surface to provide uniform cooking temperatures.

The Caloric griddle is cast with wall thickness in keeping with normal permanent mold casting design, with the exception of the area directly over the burner in which additional metal is cast to conform with a design developed by the Caloric Stove Corp. In operation, this griddle only requires approximately five minutes pre-heating at high heat, and then can be successfully used during the cooking period with a medium or low flame.

The permanent mold process imparts a slightly pebbled finish to the surface of the casting which lends itself to the final finished appearance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of the griddle without affecting the cooking action. It is often unnecessary to do any machining or polishing on the cooking surface. However, the permanent mold casting lends itself readily to a light wire brush, buffing or Monarch's Velvaglaze* process to increase sales appeal.

By careful designing, the mechanical trimming of a permanent mold griddle casting can be reduced to a minimum series of operations that compare favorably with trimming costs of other casting methods. This is particularly true when a mechanical trimming operation can serve as the basis of a decorative area of the casting, with the addition of subsequent polishing and buffing operations.

The application of aluminum in a casting subjected to heat, either direct or in a heated atmosphere, presents some special problems in design and fabrication. In such cases, it has been found desirable to discuss the design with experienced engineers during early stages of development to avoid serious problems in production.

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CLOSE WEIGHT TOLERANCE

continued from page 39

Certain parts which must remain in the cab must also move when the cab is tilted forward. One such part is the gear shift lever and the connecting transmission shaft.

The bushing illustrated is used on the linkage which allows the gear shift lever to move with the cab when it is tilted, and still keep the transmission shift rod in alignment. There is a certain amount of lateral displacement which cannot be avoided. Means must be provided to compensate for this lateral displacement, hence the spherical bushing. There is no rotation involved; rather, the transmission shift rod slides through the bushing. It carries a spline or key, which rides in the keyway provided in the bushing to prevent any rotation. Lubrication is accomplished by a normal grease connection.

Because of the service conditions for this part, the dimensional tolerances are considerably closer than are considered normal practice. The bore of the bushing is held to ± .0015, as is the spherical diameter. The concentricity is held to within .004 total indicator run-out. For a bushing of its size, these dimensional tolerances are quite close.

The shape of the piece is such that it cannot be made

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NEXT TO THE AIR ITSELF

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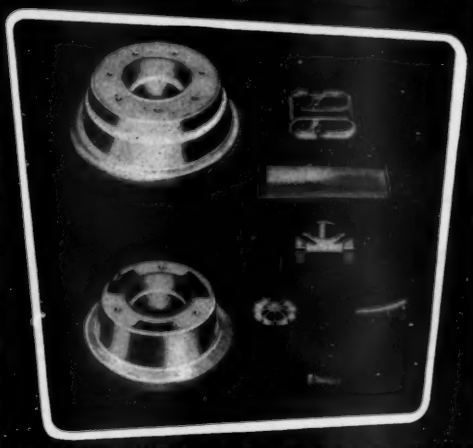

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Die casting with these new light metal alloys offers to manufacturers greater opportunities to lower production costs and the weight of their products. Also, these metals allow more freedom of design and offer greater scope in carrying out the designers' ideas. In addition, these die castings save many man-hours of finishing time.

Die Castings of magnesium or aluminum may offer you solutions to many of your cost and production problems.

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in its final form exclusively by powder metallurgical processes. The spherical face, with its associated flats at each end of the bushing, are formed by machining after the part is sintered. The hole in the side for the grease connection also must be drilled after forming and sintering operations are completed.

Even with these final machining operations, the cost is considerably less, due to reduced scrap loss and lowered labor charges, than would be its counter-part made of bar stock or bronze tubing.

Special attention has been called to the rather unusual features embodied in the parts described. It is well to remember that applications of powder metallurgy are not limited to those parts where unusual conditions in shape, dimensional tolerances, or manufacturing procedures are found.

As a general rule, powder metallurgy finds its application through economy of manufacturing methods, but in the parts described above, there is the happy coincidence of economy and the ability to achieve the unusual.

CARBIDE WAREHOUSE OPENED

The Metal Carbides Corp. of Youngstown, Ohio has announced the opening of a sales office, warehouse and service plant at 20485 Van Dyke in Detroit, Michigan. The warehouse, under the direction of A. B. Christman, will carry the company's line of carbide tools and carbide strip, bar and tube stock.

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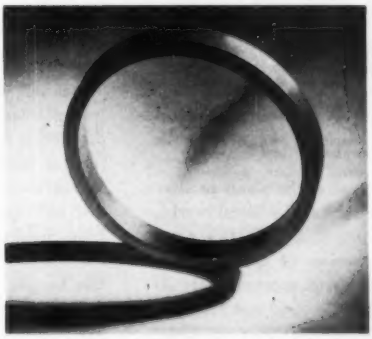
POWDERED IRON ROTATING BANDS: a report on the German wartime production.



By M. T. VICTOR*

SUCCESSFUL foreign applications of rotating bands used on projectiles from 20 m.m. up are worthy of consideration now, in view of the current efforts in this country along these lines. The majority of United States rotating bands were produced from Gilding metal or centrifugal cast copper, both strategic and scarce metals.

Prior to World War II, the Germans had used similar metals for their rotating bands. However, the original idea of utilizing sintered iron rotating bands was the brain child of the firm of Hartstaff Metall A. G. of Berlin. Statistics captured by technical teams of the United States, indicate that at least one billion sintered iron rotating bands were manufactured in the war years. As a matter of fact, in the month of December 1944, 2600 tons of iron powder were utilized for this particular application.

In 1938, the German ministry of war became cognizant of the acute shortage of copper. They directed the Hartstaff Metall Aktiengessellschaft Akmatz to develop a process for the large scale production of iron powder for a powdered iron rotating band program.

*Sales Manager, International Powder Metallurgy, Inc., Ridgway, Pa.

In 1938, the entire German iron powder production was 300 tons per year. This increased as follows:

1939	2,600 tons
1940	3,200 tons
1941	13,500 tons
1942	27,200 tons
1943	29,700 tons
1944	32,800 tons

This figure does not include carbonyl iron powder which was used for parts requiring special electrical and magnetic characteristics.

It is obvious from the above figures that the impetus given powder metallurgy in Germany was due to the rotating band program.

Let us take as an example, one of the plants producing these parts. The Vereingte Deutsche Metalliwerke, A. G. at Neurod, N. R. Ettilingen, Baden. This plant had seven mechanical type presses of approximately 34 tons; 13 rotary type presses of approximately 20 tons and two hydraulic type presses of 60 and 100 tons. With this equipment, this plant produced in 1943, 26,029,840 twenty millimeter rotating bands; 4,883,160 thirty-seven millimeter bands; 1,390,330 eighty-eight millimeter rotating bands.

In 1944, it produced 50,371,900 twenty millimeter rotating bands; 8,498,250 thirty-seven millimeter rotating band; 2,495,190 eighty-eight millimeter rotating bands. This plant operated for two months in 1945, January and February, and produced 11,524,000 twenty millimeter rotating bands; 1,286,600 thirty-seven millimeter rotating bands, and 628,700 eighty-eight millimeter rotating bands. In addition to the above rotating bands, during the period from January 1943 to February 1945, this plant also produced on an average per month 1,892,490 porous bronze and porous iron bearings; 4,182,954 other parts and 166,019,000 bullet slugs.

The other parts listed above besides iron bushings were iron and steel rifle and revolver parts. The bullet slugs were of a type that were used on service revolvers.

This company had also progressed to the point where they were producing powdered steel components for ordnance equipment.

It is interesting to note that prior to the war, this company had produced bronze bearings from a mixture of 90 per cent copper and 10 per cent tin. During the war, the tin content was reduced to 8 per cent with satisfactory results.

U. S. IRON POWDER PRODUCTION COMPARED

Let us take a moment to compare powdered iron production in the United States with the figures presented above for the German production. Below are listed figures in net tons on iron powder shipped in the United States for the years 1943 through 1950:

1943	2,135
1944	1,720
1945	1,950
1946	2,485
1947	3,115
1948	3,520
1949	3,235
1950	4,125

It is very evident in comparing the figures of German iron powder production, 32,800 tons, with our 1950 production of 4,125 tons, that before a powdered iron rotating band project could start, steps must be taken to increase production of iron powders. We might add that more powder is imported into the United States from Sweden than is produced here. Within the last few months, iron powder produced in Germany has also become available to this country.

The imported powder would not be a very stable source in the event of hostilties, therefore, it would be to our best interest if steps could be set up to increase our iron powder production.

EXTREME WEAR ON EQUIPMENT; DEVELOP OTHER METHODS

In Germany, in 1938, the ministry of war cooperated with Hartstaff-Metall Aktiengesellschaft Hametag to develop a process for the large scale production of iron powder by crushing.

The largest quantities of German iron powder were produced by the Hametag process which is crushing. The German Government authorized and financed the installation of this process at approximately 20 various plants in Germany. The largest producers were the Herman Goring Werkes. This company had large factories at Salzgitter and Helmstadte. Their total monthly production was between 1600 and 2400 tons. They had a total of 800 mills and each mill produced on an average of two to three tons per month.

In 1940, the Hametag crushing process utilized finely divided iron wire as raw material. There was sufficient raw material at the time to meet the military demands for iron powder, but later on in 1942, as demands increased to 3,000 tons per month, it was necessary to relax specifications in order to permit the use of a larger percentage of the powders being produced. This increase in tolerance doubled the production capacity by reducing the scrap.

Another problem at that time was the frequent shutdown of the mills due to the extreme wear on the equipment. The hammers in the mills were fabricated from a steel that required much manganese alloy. It became more apparent that other processes besides Hametag

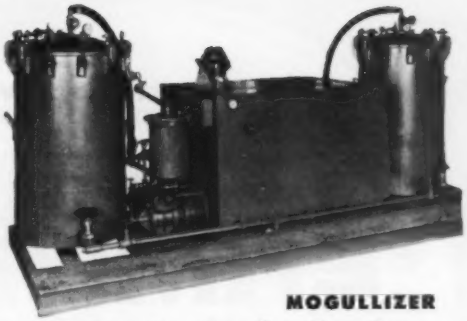
must be developed in order to provide sufficient iron powder to meet the increased demand as the war progressed. As a matter of fact, the German war ministry had at one time considered replacing the Hametag process entirely.

Some of the processes developed to replace the Hametag method of production are listed below.

The Deutsche Pulvermetallurgische Gesellschaft of Frankford developed a process of producing iron powder from a molten iron. The molten iron was atomized by a rapidly rotating bladed disc. The globules of molten metal were congealed in water or some other liquid. Each machine of this type produced about one ton of iron powder per hour. This process produced approximately 1800 tons in 1944. At the end of the war, plans had been made to increase the output to 24,000 tons by licensing other companies to use this process.

Another process was developed by Vogt and Company who had plants in Berlin and at Erlau. As a raw material, they used sponge iron imported from Hoganaes, Sweden. This is the same type of powder imported into this country at the present time. Their process was to crush the powder in machines especially developed for this process. Their production was approximately 2,000 tons in 1944. At the end of the war, their plant production was at a rate of 6,000 tons per year.

The Herman Goring Werkes at Linz had developed a special process whereby they reduced mill scale with



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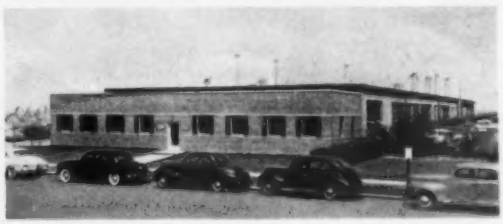

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coal. This process was late in being developed and production was started in 1944 with an output of only 600 tons. This company had planned production of 9,000 tons for 1945 when the war ended.

A very interesting method of producing iron powder was developed by Mannesman at Duisburg, Huckingen. Their process was similar to DPG's except that their molten iron was atomized by means of steam or compressed air. Their advantage was that they were able to use a raw iron of high carbon content. Their iron powder was subsequently annealed thereby reducing the carbon content. In 1940, this process produced 360 ton. At the end of the war, their production had scheduled 12,000 tons for the year of 1945.

During the last year of the war, Eisen and Metall A.G. at Eisen had developed a process of recovering iron powder from the scrap pressings which they received from the companies who produced rotating bands from iron powder. In their first year of operation, 1944, their output was 2400 tons. Their production was controlled by the amount of bands put out by this process.

The details of producing rotating bands from powdered iron might be of interest. Many previous articles have dealt with the various steps used in this country, for the production of powdered metal parts. It is needless to repeat these steps, however, it might be well to go into more detail on what processing was used for the rotating bands. The process used by the DPG plant at Frankford will be described here.

Their iron powder was all received from outside sources. Each batch was kept separate in silos designed for that purpose. The type of powder they used was in an unannealed state. In order to secure the maximum good molding characteristics, it was necessary to reduce the iron powder. This operation was carried on in a continuous type electric furnace at temperatures in the neighborhood of 1750 F.

A hydrogen atmosphere was the reducing agent. The iron powder was

maintained at maximum temperatures for about 2½ hours. It was then passed through a water cooled chamber to reduce temperature to a point where it could be handled. In the reducing operation, the powder tended to adhere together and it was necessary to reduce the lumps to powder again in a mill. The mill was operated in conjunction with a vibrating screen of about 150 mesh which separated the larger uncrushed particles. These particles were then passed through the mill again or through another mill.

The powders, as received from the vibrating screen, were mixed in a machine with a folding action in order to mix the large and small particles properly.

The powder was then placed in containers and conveyed from there to the hoppers on the molding presses. These powders were fed from the hopper directly into the die cavity by an agitating action. The die cavity was of a predetermined length and was adjustable to compensate for the different density of the powders used

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so that the molded briquettes would be of a uniform density and weight.

Pressure of approximately 16 tons per square inch was then placed upon the top and bottom rams. The molded briquette was then ejected by the bottom ram. The powder fill had been made at approximately a ratio of three to one. The briquette was sufficiently strong to withstand handling. The molded briquettes were then packed in iron boxes and taken to the next stage of the process which was the sintering or baking operation.

In the sintering operation, the parts were held at temperatures of about 2190 F. for about 2½ hours. The sintering furnaces were electrically heated and contained reducing atmosphere. It required approximately five hours for a batch to pass through the sintering operation and be cooled to a workng temperature. The rotating bands were then dumped from the iron boxes. Many of them stuck together, but they could easily be separated by hand.

The next stage in the operation was to impregnate with paraffin wax which was held at a temperature of 230 F. This operation was performed on a special apparatus in which a conveyor belt dipped the parts into the hot paraffin.

During the sintering operation, a certain amount of distortion took place in the rotating bands. Most of this distortion was in the form of shrinkage. To correct this discrepancy, parts were sized in punch presses by passing a pin through several rings.

The last stage was an inspection of both the inside diameter and thickness. It was at this stage that physical characteristics of the bands were determined. The rings were then packed in boxes and shipped to the projectile factory. Here they were placed on projectiles by automatic machines.

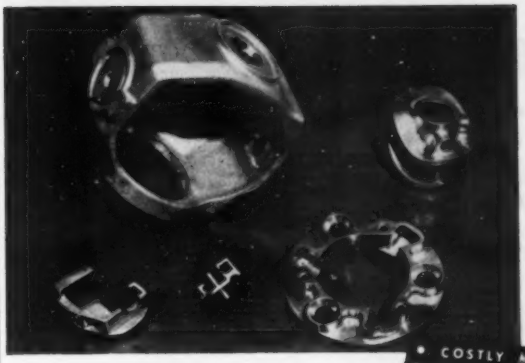
The final operation was a machining operation on the outside diameter to bring it within the required tolerance.

In another plant owned by DPG, great quantities of rotating bands were produced and a slightly different process was utilized. This plant produced a small type band. Their entire production used Hametag powder.

With this type of powder, their reducing or annealing process took place at a temperature of 1830 F. Also, in order to reduce die friction in the molding process, .5 per cent powdered wax was mixed with the powder after annealing and before molding.

Smaller size rotating bands were made on rotary presses. This type of press had from 13 to 21 stages and production was phenomenal. These special rotary presses had control gauges to control the weight and thickness of the band. Using the Hametag iron, the compacts could be sintered at temperatures as low as 1830 F. in a pure hydrogen atmosphere. In this branch plant, they used gas-fired instead of electric-fired furnaces.

It was also found that loose powder adhered to the bands and in order to remove this powder, after sintering, it was necessary to tumble the sintered bands. This also tended to separate bands which adhered to one another in the sintering operation.



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Using a rotary press, a greater discrepancy was found in the weight of the small rotating bands. It was therefore necessary to pass all of the sintered bands through automatic weighing machines which segregated the parts into various classes.

These small bands were also sized to bring them back within the dimensional tolerances. However, the sizing operation tends to work-harden the part. It was therefore necessary to relieve stresses by an annealing operation which was performed in the same furnaces as used for sintering with the identical reducing atmosphere. The parts were again tumbled to again remove powder particles which adhered to the parts.

At that time, a corrosion condition became evident. This was overcome by passing the completed bands through bonderizing machines and then dipping in cellulose varnish. This last process left a thin film of varnish on the bands.

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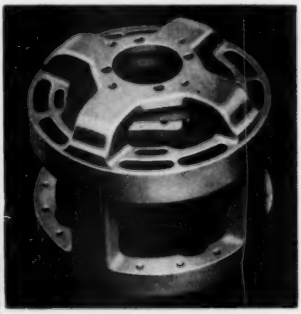

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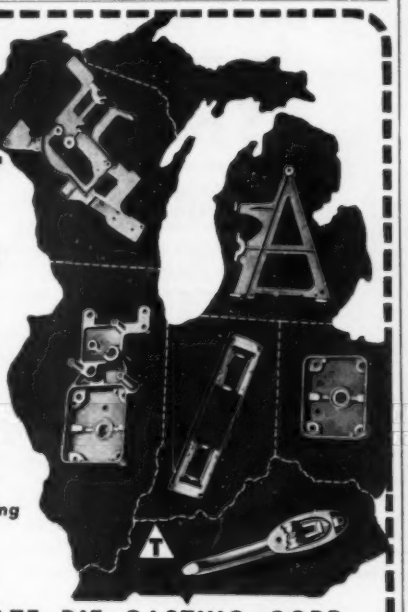

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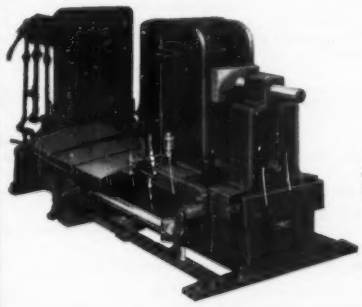

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A Note to Executives

Some facts about Oilite Products

Essentially, Oilite metal powder products constitute a new series of metals—each formulated to do a specific job. When used as replacements for tin, aluminum, copper, and other strategic materials, they often become permanent replacements.

For example, on any unit where motion occurs, Oilite provides the otherwise unobtainable feature of self-lubrication.

As with any other new material, habitual specifications should often be reviewed when considering Oilite finished machine parts. To illustrate, designers using cold rolled steel, may automatically apply the strength specifications of that material. The engineer, however, knows that strength as low as 40% of steel is satisfactory.

Another advantage of Oilite is its broad range of physical properties. Thus, when high stresses exist, Oilite engineers specify the correct material necessary to meet the requirements.

When production, including mass quantities, must be reached in record time, Oilite bearings and finished machine parts may provide you with an excellent reservoir.

President

OILITE PRODUCTS

OILITE PRODUCTS:
Heavy duty, oil-cushioned, self-lubricating bearings and finished machine parts in ferrous and nonferrous metals and alloys. Permanent filters. Friction units. Self-lubricating cored and bar stock.

For further information circle No. 11 on the Reader Service Card.

Thousands or Millions....

ALUMICAST can produce quality castings in quantity, exactly to your specifications

Let ALUMICAST give you a helping hand with your casting problems. You'll be agreeably surprised with the results if you ask our nationally recognized authorities in research, metallurgy, engineering and production to put their know-how to work for you.

Here at ALUMICAST, we have the most modern laboratory and production equipment to make permanent mold and die castings in aluminum or magnesium. Every step, from ingot to casting, is rigidly regulated. The quality of ALUMICAST castings is outstanding because of expert scientific control. This value, we call "E.S.C.", is of great importance to you. It helps make good products better.

No matter where you are located, you are cordially invited to consult us about your casting requirements for civilian or defense needs. We have sales engineers and representatives in leading cities. If you do not know the name of our man nearest you, write direct to us. ALUMICAST CORPORATION, 1523 N. Kilpatrick Avenue, Chicago 51, Illinois.

ALUMICAST "E.S.C." EXPERT SCIENTIFIC CONTROL

ALUMINUM and MAGNESIUM PERMANENT MOLD and DIE CASTINGS

For further information circle No. 20 on the Reader Service Card